1986

An empirical assessment of defense contractor risk 1976-1984.

Martin, Wayne A.

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN EMPIRICAL ASSESSMENT OF
DEFENSE CONTRACTOR RISK
1976-1984

by

Wayne Anthony Martin

June 1986

Thesis Advisor: Dan. C. Boger

REPORT DOCUMENTATION PAGE

a REPORT SECURITY CLASSIFICATION

1b. RESTRICTIVE MARKINGS

a SECURITY CLASSIFICATION AUTHORITY

3 DISTRIBUTION/AVAILABILITY OF REPORT
Approved for public release: distribution unlimited

b. DECLASSIFICATION/DOWNGRADING SCHEDULE

PERFORMING ORGANIZATION REPORT NUMBER(S)

5 MONITORING ORGANIZATION REPORT NUMBER(S)

a. NAME OF PERFORMING ORGANIZATION
aval Postgraduate School

6b OFFICE SYMBOL *(If applicable)*
Code 54

7a. NAME OF MONITORING ORGANIZATION
Naval Postgraduate School

c. ADDRESS *(City, State, and ZIP Code)*
onterey, California 93943-5000

7b. ADDRESS *(City, State, and ZIP Code)*
Monterey, California 93943-5000

a. NAME OF FUNDING/SPONSORING ORGANIZATION

8b. OFFICE SYMBOL *(If applicable)*

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

c. ADDRESS *(City, State, and ZIP Code)*

10 SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO

TITLE *(Include Security Classification)*
n Empirical Assessment of Defense Contractor Risk 1976-1984

PERSONAL AUTHOR(S)
artin, Wayne A.

a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
aster's Thesis	FROM ______ TO ______	1986 June	183

SUPPLEMENTARY NOTATION

COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
Risk, Profit, Contracting, Acquisition, Market structure

ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This thesis attempts to analyze and measure the relationship between defense contractor risk and rate of return. An historical perspective is gained through an extensive review of significant legislation, studies, and policy changes related to this topic. The government contracting environment and the associated risks are examined from the perspectives of both the government and contractors. The nature of risk and methods of risk analysis are investigated. Empirical analysis of the defense contractor risk-return relationship is performed utilizing four methods: mean-variance analysis of rate of return, the Capital Asset Pricing Model, mean-variance analysis of total and government backlog, and mean-variance analysis of Five-Year Defense Program elements. Emphasis is placed on investigating the feasibility of adapting Gloria Hurdle's Leverage, Risk,

0 DISTRIBUTION/AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS

21 ABSTRACT SECURITY CLASSIFICATION
Unclassified

2a NAME OF RESPONSIBLE INDIVIDUAL
Dan C. Boger

22b TELEPHONE *(Include Area Code)*
408-646-2607

22c OFFICE SYMBOL
Code 54 Bo

ABSTRACT (Continued)

Market Structure and Profitability Model to evaluate the Department of Defense contract pricing, financing, and profit policies.

Approved for public release, distribution unlimited

An Empirical Assessment of Defense Contractor Risk 1976-1984

by

Wayne Anthony Martin
Lieutenant Commander, United States Navy
B.S., Auburn University, 1974

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1986

ABSTRACT

This thesis attempts to analyze and measure the relationship between defense contractor risk and rate of return. An historical perspective is gained through an extensive review of significant legislation, studies, and policy changes related to this topic. The government contracting environment and the associated risks are examined from the perspectives of both the government and contractors. The nature of risk and methods of risk analysis are investigated. Empirical analysis of the defense contractor risk-return relationship is performed utilizing four methods: mean-variance analysis of rate of return, the Capital Asset Pricing Model, mean-variance analysis of total and government backlog, and mean-variance analysis of Five-Year Defense Program elements. Emphasis is placed on investigating the feasibility of adapting Gloria Hurdle's Leverage, Risk, Market Structure and Profitability Model to evaluate the Department of Defense contract pricing, financing, and profit policies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. PURPOSE

Over the past thirty-five years numerous defense contractor profitability and risk studies have been conducted. The basic premise of these studies has been to examine the profitability of defense industry firms in comparison with commercial firms. They sought to answer the questions: Are defense contractor profits excessive, thereby wasting our national resources? Are profit rates too low, thereby jeopardizing our defense industrial base? Previous studies have been widely criticized for biased premises, nonrepresentative samples, inaccurate data, and misleading variations in statistical averages. The most recent significant study, the Defense Financial and Investment Review (DFAIR), chartered as a result of Grace Commission recommendations for further study of contract pricing, financing, and profit policies, attempted to minimize those difficulties for which previous studies were criticized [Ref. 1]. None of the prior studies has totally reconciled the fact that rates of return are not completely comparable for having been earned under varying exposures to risk. Rather than ask what defense contractors' observed rates of return are, a more appropriate question would be whether defense contractors are appropriately rewarded for creative and wise risk taking. This is a complex and contentious issue. One problem has been the lack of generally accepted methods for the evaluation and quantification of defense contractor risk.

The purpose of this thesis is to empirically analyze four possible methods for the evaluation and quantification of defense contractor risks. First, the most commonly used method, mean-variance analysis of rate of return, is examined. Average risk-adjusted rates of return for a sample of 49 defense contractors, a sub-sample of 36 commercially-oriented contractors, and a sub-sample of 13 DOD-oriented contractors are obtained. Then the Capital Asset Pricing Model (CAPM) is tested with regard to the same three sample groups of contractors. The third method is mean-variance analysis of both total and government backlog for the same three sample groups of contractors. The fourth method is mean-variance analysis of Five-Year Defense Program elements.

B. OVERVIEW

Analysis of government contractor risk and the interrelationship of that risk with other variables is complex. Consequently, a broad-view approach is adopted in order to form a basis for further study.

Essential to a study such as this is an appreciation for previous work on the topic. Thus, in Chapter II we explore the most significant legislation, studies, and policies which address government contractor profitability and risk. The amount of literature available on this and related topics is vast. However, much of it is redundant and focuses on comparing defense contractor profits with those of comparable commercial firms. A relatively small amount of work has been performed in the area of profit, risk, financing, and market structure relationship analysis. The recent Defense Financial and Investment Review points us in this direction with the suggestion that we integrate these policies for the Department of Defense.

Armed with an historical perspective, a full understanding of government contracting issues from the view of both the government and the contractor would be a logical next step. Therefore, Chapter III examines these government contracting issues.

Because the concept of risk is complex and relationships between risk and other variables are not always clear, Chapter IV investigates the concept of risk, emphasizing basics. Chapter IV also addresses government and contractor concerns regarding risk.

Chapter V attempts to empirically assess four measures of risk for possible future inclusion in a model to evaluate risk-return relationships among defense contractors. Variability of return on net worth, stock prices, backlog, and R&D program funding are the measures which are analyzed.

Particular emphasis is given to possible development of a model integrating profit, risk, financing, and market structure, as suggested by DFAIR, for defense contractors.

II. HISTORICAL PERSPECTIVE

This chapter explores the genesis of defense contracting profit policy. Of particular interest in this investigation is the study of the variability of returns and the risk versus return relationship.

A. VINSON-TRAMMEL ACT

Accusations of war profiteering have plagued defense contractors since the days of the Revolutionary War. Some accusations have been justified. However, it was not until 1934 when the Senate held the highly publicized "Nye Hearings," an investigation of a chemical company that earned $248 million net before taxes on $1.2 billion military sales from 1915 to 1918, that legislation was considered. The first attempt to legislate profit came in the form of the Vinson-Trammel Act of 1934 which limited profit on contracts for ships and aircraft to 10 percent and 12 percent, respectively. The act required contractors to return all profits in excess of those limits. Whether the post World War I profiteering scandals affected the corporate strategies of defense contractors or not, Dr. Weidenbaum observes:

> A fundamental change in the relationship between shooting war and military profits seems to have occurred since the beginning of the twentieth century. Although the

> production of weapons for a military buildup can be quite profitable, all objective measurements point to the fact that business profitability declines during an actual war. Corporate profits declined as a share of national income during World War II and the wars in Korea and Vietnam. [Ref. 2:p. 67]

He also observes:

> Peacetime military expansions are quite another matter. When the U.S. was mobilizing its "arsenal for democracy" from 1939 to 1941, the American economy was climbing out of the depression; corporate profits (even after taxes) almost doubled, from $5.6 billion in 1939 to $10.1 billion in 1941. This upturn in company earnings ended with Pearl Harbor, however. Although the GNP almost doubled from 1941 to 1945, corporate profits after taxes declined to $9 billion in 1945 (the drop was far more substantial in "real" terms). Following the massive reduction in military spending after the war, corporate profits rose to $23 billion in 1948. A similar relationship held before and during the Korean and Vietnam Wars. [Ref. 2:p. 68]

B. ARMED SERVICES PROCUREMENT ACT

After the Vinson-Trammel Act of 1934, the next significant legislation came in the form of the Armed Services Procurement Act of 1947. This was enacted to regulate Department of Defense (DOD) procurement. It provided the Armed Services Procurement Regulation (ASPR) to implement the requirements of the act. A major requirement of this act was to utilize formal advertising as the basic method of government procurement except when conditions fell within one or more of 17 exemptions permitting use of negotiation as the method of procurement. In procurement by formal advertising, contractors are invited to submit bids for goods and services. The responsive and responsible contractor with the lowest bid is awarded the contract. In procurement by negotiation, contracts can be awarded competitively or noncompetitively and discussion of proposals is permitted. [Ref. 3]

C. RENEGOTIATION ACT

The next significant legislation was the Renegotiation Act of 1951. This was enacted to eliminate contractors' excessive profits on defense and space contracts and subcontracts. The Renegotiation Board, an independent agency, was created by the act to administer the program. The act required all contracts of $100,000.00 or more to contain a renegotiation clause which could be invoked by the DOD component department secretary. The Renegotiation Board was empowered to require contractors to return profits it considered excessive. The Renegotiation Act was extended twelve times between 1951 and 1975 but was allowed to expire by Congress on December 31, 1975. Congress decided at that time that the provisions of the act were a costly administrative burden on reporting firms, tended to penalize smaller contractors, and were no longer needed. Opposing views regarding renegotiation are characterized by the following studies: The Comptroller General's Report to the Congress, <u>Causes of Excessive Profits on Defense and Space Contracts</u>, puts forth the following proposition:

> Contracts resulting in excess profits were negotiated, as well as formally advertised. The required price or

cost analyses were made before the contracts were negotiated. Most excessive profits were caused by a seller's market which lessened competition and let prices increase. When contractors' volume rose, frequently unit production costs were reduced and profits were increased. Excessive profits were not caused to any great extent by inadequate procurement procedures or poor implementation of procedures by Government procurement officials. Implementation of good procurement procedures will not necessarily prevent excessive profits. Renegotiation is needed as long as the Congress intends to recover excessive profits on procurements for national defense. [Ref. 4]

The Defense Financial and Investment Review (DFAIR) puts forth an opposing view:

> The DOD position has been that the best approach to avoiding excess profits is good pricing. Given an adequate number of well-trained contracting officers with supporting field auditors and pricing personnel, and with the protection provided by the Truth in Negotiations Act and fraud statutes, there is no reason why excess profits should be a significant problem. Cost accounting standards have superseded the allocation disputes which were the heart of many of the Renegotiation Board's findings of excess profits. Finally, good pricing has the advantage of encouraging cost control, because a contractor must underrun tight costs to earn a high profit. The renegotiation approach, on the other hand, would tend to encourage contractors to attempt to increase costs on profitable contracts, rather than to cut costs still further. [Ref. 1:pp. V4-V5]

The DFAIR view appears to be more appropriate as evidenced by recent contractor suspensions resulting from Defense Contract Audit Agency (DCAA) audits [Ref. 5].

D. WEIGHTED GUIDELINES

On January 1, 1964 the first uniform, systematic approach to developing profit policy objectives for negotiated contracts, entitled Weighted Guidelines (WGL), became effective. This method, although changed several times since implementation, was and still is used by contract negotiators to provide rewards commensurate with contractor effort; contractor risk; facilities investment; and special factors such as productivity, independent development, and other special factors applicable under the original directive, ASPR Defense Acquisition Regulation (DAR) 3-808. This regulation provided a structured approach to analysis of contractors' cost input, cost risk, past performance, as well as other pertinent factors.

Table 1 lists the factors considered in cases where cost analysis is used to arrive at a negotiated contract price together with corresponding weight ranges. Table 1 also summarizes changes to the markup policy which have occurred since implementation. Specific weight percentages are now assigned in accordance with criteria set forth in the Federal Acquisition Regulations (FAR), DOD Supplement 15.9. The cost of each subfactor is multiplied by this percentage to arrive at the profit objective for that particular effort. The sum of the individual profit objectives yields an overall contract profit objective.

Since its implementation in 1964, the WGL method has been the subject of scrutiny and criticism. Criticized initially for being too subjective, the WGL method has proven itself capable of at least providing similar profit objectives for similar contracts. The fact that the WGL method is cost-based has evoked substantial criticism.

TABLE 1

PROFIT POLICY CHANGES

Weighted Guidelines Markup Objective	Before Profit '76	DPC 76-3	DAC 76-23		
	All Contracts	All Contracts	Mfg.	R&D	Services
Contractor Effort:					
Direct Materials:					
Purchased Parts	1-4%	1-4%	1-4%	1-4%	1-4%
Subcontracts	1-5%	1-5%	1-5%	1-5%	1-5%
Other Materials	1-4%	1-4%	1-4%	1-4%	1-4%
Engineering Labor	9-15%	9-15%	9-15%	9-15%	N/A
Engineering Overhead	6-9%	6-9%	6-9%	6-9%	N/A
Manufacturing Labor	5-9%	5-9%	5-9%	5-9%	N/A
Manufacturing Overhead	4-7%	4-7%	4-7%	4-7%	N/A
Services Labor	N/A	N/A	N/A	N/A	5-15%
Services Overhead	N/A	N/A	N/A	N/A	4-8%
G&A Expense	6-8%	6-8%	6-8%	6-8%	6-8%
Adjustment Factor	N/A	(1)	(1)	N/A	N/A

TABLE 1 (continued)

Weighted Guidelines Markup Objective	Before Profit '76	DPC 76-3	DAC 76-23		
	All Contracts	All Contracts	Mfg.	R&D	Services
Contractor Risk	0-7%	0-8%	0-8%	0-7%	0-4%
Facilities Investment	N/A	6-10%	16-20%	N/A	N/A
Record of Performance	-2-2%	N/A	N/A	N/A	N/A
Selected Factors	-2-2%	N/A	N/A	N/A	N/A
Special Factors:					
Foreign Military Sales	1-4%	1-4%	N/A	N/A	N/A
Independent Development	1-4%	1-4%	1-4%	1-4%	N/A
Productivity	N/A	(2)	(2)	N/A	N/A
Other	N/A	-5-5%	-5-5%	-5-5%	-5-5%
Cost of Money Adjustment	N/A	(3)	(4)	(4)	(4)

(1) 30% of effort
(2) Cost decrease multiplied by base markup rate.
(3) CAS 414 provided allocation of cost of capital to contracts.
(4) Dollar-for-dollar cost of money instead of 30% adjustment factor.

Source: [Ref. 1:p. V17]

Because profit is calculated as a percentage of cost, some argue that contractors are induced to keep costs high. Others contend that, because contractors operate within Return on Investment (ROI) and Return on Equity (ROE) strategies, the government's cost-based approach is not realistic. These and similar controversies were the initial sparks setting off the wave of "profit studies" which soon followed. [Ref. 6]

E. LMI, WEIDENBAUM, AND GAO STUDIES

In 1967 Senator William Proxmire (D, Wis.), Chairman, Joint Economic Committee was grappling with claims of war profiteering. Senator Proxmire obtained secret reports which the Pentagon used to annually review negotiated profit rates. He compared data from two periods 1959-1963 and 1964-1967 and discovered a 22 percent increase in profit rates between the two periods. DOD cited a Logistics Management Institute (LMI) study, Defense Industry Profit Review Task 66-25, November 1967 [Ref. 7], in an attempt to demonstrate that while negotiated profits did increase, actually realized profits did not.

This LMI study examined financial data from 1958 to 1966 for 65 defense contractors. It compared profits on defense business with those on commercial business for the 65 contractors. Comparisons with profits of similar commercial manufacturing contractors were also made. The

LMI study found that there was a general downward trend in defense business profitability, an upward trend in the profitability of commercial business, and average profits were lower on defense business than on commercial business. Defense contractor average profits were found to be lower than average profits for similar commercial manufacturing contractors. Critics of the LMI study immediately identified a major flaw in the data collection method. That is, only companies who volunteered data were used, thereby excluding companies with high rates of return.

Also in 1967, Dr. Weidenbaum compared six large defense contractors (defense work accounted for at least 75 percent of total sales) with six commercial firms having similar sales volume, over two four-year periods, 1952-1955 and 1962-1965 [Ref. 8]. He concluded that while defense-oriented firms had a lower return on sales, they had a greater return on net worth than the commercial firms had. For the 1962-1965 period the defense contractors had a 17.5 percent return on investment (ROI) while commercial firms for the same period had a 10.6 percent ROI. These returns were lower than the 1952-1955 period but the spread was wider. Dr. Weidenbaum attributed this disparity to the fact that the defense contractors had a higher capital turnover rate due to government-owned plant and equipment and progress payments.

Critics claimed that Dr. Weidenbaum's data was limited and that his sample size was too small. However, this study was significant in that it was one of the first studies to relate these higher returns to investor risk. Dr. Weidenbaum, in referring to his 1967 study, "Arms and the American Economy: A Domestic Convergence Hypothesis", states:

> The stock and bond market evaluation has generally been less favorable of the large specialized defense contractors than of other business firms; the defense contractors' stocks usually sell at lower prices than stocks of other companies with similar earnings, and their bonds generally have lower ratings, denoting greater investor risk. This is caused in part by the instability of the military market and the uncertain future of specific firms. The experiences of firms like Lockheed in the period since 1965 show that for the individual company the profitability of military work may be fleeting. [Ref. 2:p. 68]

Another significant study conducted in 1967 was Fisher and Hall's Risk and the Aerospace Rate of Return [Ref. 9]. They addressed the question of whether the above-average rate of return on net worth earned by 88 aerospace firms for the period 1957-1964 resulted from above-average risk exposure. Fisher and Hall's development of a method for obtaining risk-comparable corporate rates of return was a pioneering work in this area. Significant results produced by Fisher and Hall were, on the basis of reasonable assumptions, to measure the risk component of corporate profits and to determine that the aerospace rate of return remained the second highest even after adjusting for risk. They caution, however, that profits are affected by many more factors than risk. And they emphasize the fact that they isolated the risk factor for purposes of this study.

In 1969, LMI continued its 1967 study. This time they used total capital investment (TCI) as the base of their profitability measure. LMI found that average defense profit as a percent of TCI trended downward while average commercial firm profits trended upward. They concluded that profit inequities exist because differences in capital requirements are not reflected in defense profit rates and they recommend that capital requirements be given greater consideration in negotiated contract profit determinations. [Ref. 10]

The 1970 continuation of the LMI <u>Defense Industry Profit Review</u>, based on 1958-1968 data, supported findings of the 1967 and 1969 studies [Ref. 11]. That is, there is a low average profit on defense business as compared with commercial business, profit inequities exist as a result of different capital requirements, and there is an increased capability of defense contractors to compete in commercial markets.

As a result of the mixed results from previous studies, the Joint Economic Committee of Congress holding hearings on the Acquisition of Weapons systems in 1969 directed the General Accounting Office (GAO) to make an independent study of the subject of defense profits in depth. GAO examined profits on negotiated contracts and subcontracts with DOD, NASA, and the Coast Guard. Profits of 74 large contractors, 61 small contractors, and 10 subcontractors were compared on the basis of return on sales, return on equity capital, and return on total capital investment. Results of GAO's study, published in 1971 [Ref. 12], were: return on sales before taxes on defense work was 4.3 percent compared to 9.9 percent for commercial work, return on total capital investment was 11.2 percent for defense work compared to 14 percent for commercial work, and return on equity capital was 21.1 percent for defense work compared to 22.9 percent for commercial work. Dr. Weidenbaum notes three important distinctions made in the GAO study:

- Prime contractors show a higher return on investment on military work than do companies that specialize in subcontracts (only 15 percent for the latter). In part, the difference is accounted for by the fact that the prime contractors pass very little of the progress payments they receive from the government on to their subcontractors. Also, the subcontractors obtain very little in the way of government-owned facilities, which tend to be concentrated among the prime contractors.

- Large defense contractors show a higher profit rate on military work than do smaller companies (21 percent as compared to 11 percent). Again, the latter receive very little government capital.

- Aerospace and also ammunition companies show a much higher profitability on defense work than do other military contractors. Their profits on defense work are also higher than the profits on their commercial sales. The aerospace firms show an average 28 percent return on investment for defense work, compared to an 18 percent return for commercial work. These companies are more oriented to military work than the other industries that compete for military business. [Ref. 2:p. 69]

The GAO study settled nothing. Critics and supporters continued to disagree.

During this same timeframe, the Aerospace Industries Association of America, Inc. (AIA) performed a thorough examination of the nature of risk involved in government contracting. The results of their study, Risk Elements in Government Contracting [Ref. 13], consist of eleven key areas of risk which were identified and subjectively assessed: contract type, warranties and related liabilities, ultra-hazardous work indemnification, disallowance of costs, funding, termination, cost or pricing data, contract breaches, facilities investment, patents and technical data, and management systems and controls. Another AIA study, Aerospace Profits vs. Risks [Ref. 14], investigated the adequacy of aerospace profits from 1966-1969. AIA addressed the risk-return relationship. But they provided no empirical evidence to substantiate their conclusions that the riskiness of aerospace work had increased as a result of an increase in production risk and an obvious shift of risk from the government to the contractor.

Unable to reconcile the shortcomings in the LMI, Weidenbaum, and GAO studies, Bohi constructed a sample of 36 defense contractors for analysis from 1960 through 1969 [Ref. 15]. His comparisons of return on net worth with the Fortune "500" largest manufacturers yielded the findings that profit performance between defense firms and commercial manufacturing firms was not significantly different; there was no apparent relationship between percentage of defense business and profit performance; the Weidenbaum "domestic convergence hypothesis" that defense business is becoming more concentrated in the traditional defense firms and that these defense firms are becoming increasingly dependent on defense business was not supported; and profit rates for the 36 defense firms and the <u>Fortune</u> "500" manufacturers increased during the Vietnam war period but the increase was due to nondefense business. Bohi concluded:

> On the basis of the sample of 36 defense contractors considered here, it is concluded that there is no evidence for arguing that defense business is any more or less profitable than nondefense business in general. Whether or not this result implies that defense profits are too high or too low depends, of course, on the relative risk and relative efficiency of defense and nondefense business. The current public debate has abstracted from these issues and concentrated on comparisons of profit performance. It appears, however, that relative risk and relative efficiency, not relative profit performance, are the important issues. [Ref. 15:p. 728]

F. DEFENSE PROCUREMENT CIRCULAR 107

In 1972 DOD issued Defense Procurement Circular (DPC) 107 in order to correct perceived inequities in the WGL method. Factors were added to base part of the profit objective on operating capital and facilities capital utilized in contract performance. DPC 107 was implemented on a voluntary, trial basis to compensate contractors for use of capital and to move toward a return on investment approach. However in 1975 after only one contractor opted to utilize the DPC 107 method, DPC 107 was withdrawn. Contractors believed profits would not increase, that the procedures were overly complex, and that it would penalize contractors with little capital investment. [Ref. 1:p. V1]

G. CARROLL STUDY

Carroll's 1972 study, "Profits in the Airframe Industry" [Ref. 16], analyzed return on invested capital with attention given to intra- and interindustry comparisons and to the effect of risk for eight airframe manufacturers from 1957-1966. Government-oriented companies had mean returns of 15.6 percent and a standard deviation of 2.08 compared to the airliner producers with a mean of 9.3 and standard deviation of 10.08. Risky government contracting in the sense of highly volatile returns was not evident from these results. Quite the opposite, high profits did not correlate to high volatility in earnings. Investigation of debt-to-equity ratios for commercial and government firms indicated that leverage was similar to that existing in comparable manufacturing industries. Therefore, leverage did not account for the substantial defense contractor earnings premiums. Carroll concluded:

> Two distinct markets provide the bulk of demand for the industry's product. The government sector is essentially a bilateral monopoly, while the commercial airliner area is a tight bilateral oligopoly. To gain insight into the source of profits for the industry, these two markets must

be considered separately. When this is done, starkly different patterns emerge for the two sectors. First, the commercial market exhibits an endemic instability with subcompetitive levels of profit. More important, as will be evident, supercompetitive returns have been customary in the government airframe business and have, further, provided an implicit subsidy to the commercial airliner market. [Ref. 16:pp. 545-562]

H. POIRIER AND GARBER STUDY

In an October 1974 Southern Economic Journal article titled "The Determinants of Aerospace Profit Rates 1951-1971" [Ref. 17], Poirier and Garber respecify a linear regression model developed by Agapos and Gallaway and test the following hypotheses:

(1) The level of capacity utilization is directly related to the level of federal government spending. High levels of such expenditures will reduce excess capacity and thus reduce the need to be awarded any single contract. This reduced need will be translated into greater bargaining strength and greater realized profit rates.

(2) Conditions of war should be accompanied by a greater sense of urgency on the part of government agencies and thus a reduction of bargaining strength of the government vis-a-vis contractors. This may be expected to result in higher realized profits for government contractors. [Ref. 17:pp. 228-238]

Empirical results of the model for nine airframe manufacturers for the period 1951-1971 were different from those obtained by Agapos and Gallaway. By breaking down defense spending into components, Poirier and Garber found space and R&D expenditures positively correlated with profit rates. Procurement expenditures were found to be negatively correlated with profit rates. By representing time with a linear spline function they found that such a representation explained a significant proportion of the residual variation of profit rates and it allowed for separation of effects of war and peace. This study concurs with the 1967 Rand Corporation study conducted by Fisher and Hall, Risk and the Aerospace Rate of Return, which noted that several adjustments were required to obtain empirical relationships that coincided with theoretical concepts. Specifically, adjustments for trend and autocorrelation were particularly important.

I. HURDLE STUDY

In her November 1974 paper, "Leverage, Risk, Market Structure and Profitability" [Ref. 18], Gloria Hurdle attempted to analyze and measure the relationships among leverage, market structure, risk and profitability by developing a three-simultaneous-equation multiple regression model and testing it. She tested the model using data developed by Shepherd for 231 large U.S. manufacturing firms covering the period 1960-1969. [Ref. 19] A second test was made using a sample developed by the Internal Revenue Service (IRS) consisting of data from 85 minor manufacturing industries covering the period 1959-1967. [Ref. 20]

Hurdle theorized that since the relationships among risk, earnings, and leverage depend on the utility functions of firms, they must be determined empirically. Consequently, in her model, she used the following three dependent variables: risk, financial structure, and rate of return. Her initial hypothesis was that the deviation in rate of return could be used to measure total risk.

1. Risk Equation

The results which Hurdle obtained from her risk equation were statistically significant. The signs of her regression coefficients fit most of her a priori expectations. She found that firms with a large market share had the advantage of lower profit variation. She found the same to be true for advertising intensive firms. These results were consistent with her hypotheses.

The finding that capital intensive firms, that is firms with large assets to sales ratios, appeared to have more stable profits was contrary to expectation. She explains:

> A plausible explanation for the negative coefficient is that the existence of large fixed costs forces the firm to be cautious and strive for stable profits over time, contrary to Scherer's expectation. [Ref. 18:p. 481]

Scherer expected the coefficient sign of the assets/sales variable to be positive since he theorized that capital intensive firms would be more likely to engage in price cutting. [Ref. 21]

The coefficient sign of the concentration variable also went against expectation. Hurdle expected that if her concentration variable measured tightness of an oligopoly then it should represent the ability of a firm to control price and therefore would have a negative coefficient. She explains the positive coefficient she obtained:

> An oligopoly group may have a higher rate of return, but with more variability.

Industry demand affected profit variability as expected. That is, large demand fluctuations were related to large profit variations.

Finding the coefficient of the debt variable to be statistically insignificant supported her a priori expectation that debt is an inappropriate measure of business risk.

Hurdle concludes from her risk equation:

> These results indicate that market structure does play a part in determining the size of profit deviations. Firms with a large market share, with large advertising expenditures, and with high assets tend to stabilize their high level of profits over time. [Ref. 18:p. 482]

2. Debt Equation

Hurdle expected all the market structure variables in the debt equation to have coefficient signs opposite of the signs found in the risk equation. This was because she theorized that variables which lowered risk should increase the opportunity for high debt. Her results indicated that firms with large market share preferred lower debt.

Her concentration variable, negatively related to debt while positively related to risk, supports her theory. Her capital intensity variable also supports her theory that variables which lowered risk increased debt.

Hurdle explains the negative profit coefficient she obtained amid conflicting expectations:

> First, if one believes the "risk premium" argument, then one would associate high profits with high risk and claim that π in this equation is acting as a partial proxy for risk. In other words, those firms with high profits are deemed risky by investors. Second, even if the firm's view of risk corresponds to the measured risk, σ, the coefficient may reflect the choice of the firm based on its utility function. [Ref. 18:p. 483]

The size variable had the same sign in both the risk and debt equations. Hurdle argues that large firms behave like firms with a large market share preferring lower risk to increased profits possibly because of antitrust action.

The growth variable exhibited the expected positive sign. This supports the theory that expanding firms require higher leverage.

The profit variation coefficient was found to be statistically insignificant. The standard errors of the regression coefficients in the debt equation were large. Therefore, any conclusions would be weak statistically. Hurdle concludes:

> There is some evidence that large firms and/or firms with large market shares are not taking advantage of their ability to increase profits through higher debt, and thus, as the theory suggests, are being more cautious or are accepting lower risk. [Ref. 18:p. 483]

3. Profit Equation

The coefficients of the debt and risk variables of the profit equation yielded conflicting results under ordinary least squares and two-stage least squares. However, Hurdle does conclude that a firm with high debt has a higher return on equity.

The risk coefficient supports the risk premium hypothesis. That is, a firm must have higher profit in order to take on more risk.

4. Industry Sample

Because of the conflicting results obtained from the profit equation, Hurdle analyzed a second sample consisting of 85 minor manufacturing industries. As a result of this industry analysis, Hurdle was able to reject the hypothesis that debt could be used to measure risk.

J. PROFIT '76

DOD became increasingly aware that its profit policy, Weighted Guidelines, based on cost estimates, discouraged contractor investment and rewarded high cost. Consequently, on May 13, 1975 Deputy Secretary of Defense William Clements directed that a full-scale study of DOD profit policy be conducted. Secretary Clement's goal was to develop profit policy revisions such that defense contractors would be motivated to invest in new facilities, invest in new equipment, and eliminate outmoded methods of production; thereby reducing costs. This study, Profit '76, performed in response to criticism that low productivity resulted from little or no capital investment which in turn resulted from low profit and high risk, looked at profitability from two perspectives: return on sales and return on total assets less progress payments. These rates of return for defense contractors were compared to Federal Trade Commission (FTC) durable goods producers. Profit '76 [Ref. 22] concluded that pre-tax return on sales was higher for FTC durable goods producers than for defense contractor profit centers. The five year (1970-1974) average return on sales was 6.7 percent for FTC durable goods producers and 4.7 percent for defense contractor profit centers. Profit '76 further concluded that pre-tax return on sales actually realized on government contracts was significantly less (approximately 46 percent) than that negotiated by contracting officers. The study group felt that this was due to cost overruns and not to a problem which could be solved by DOD profit policy. The pre-tax return on total assets for defense contractor profit centers was found to be higher than that for FTC durable goods producers. The five year (1970-1974) average return on assets was 13.5 percent for defense contractors and 10.7 percent for FTC durable goods producers. The study group felt this was due to defense contractor financing being more favorable than in the commercial sector and contractor capital investment being less for defense contractors than for commercial producers. Looking at assets/sales, the study group found that the difference in investment was significant; the five year (1970-1974) average assets/sales was 63 percent for FTC durable goods producers compared to 35% for defense contractors.

K. DEFENSE PROCUREMENT CIRCULAR 76-3

Policy revisions recommended by the Profit '76 study group were implemented in Defense Procurement Circular (DPC) 76-3 effective October 1, 1976. The following changes to DOD profit policy were made:

- imputed cost of capital for facilities investment became an allowable cost on negotiated contracts (Cost Accounting Standard (CAS) 414);

- level of facilities investment was assigned a weight from 6 percent to 10 percent;

- a 30 percent adjustment factor was added to WGL to eliminate increased profits which would possibly result from the two changes above;

- the spread in weights for contractor risk was increased to account for difference in risk between cost reimbursable and fixed-price contracts;

- productivity was added as a WGL factor; and

- record of performance and special factors were eliminated.

These policy revisions were designed to reward investment of facilities capital and penalize failure to invest. Table 1 summarizes these policy changes with those in effect prior to DPC 76-3. [Ref. 1:p. V2]

On February 17, 1977 GAO advised the Secretary of Defense that the new profit policy provided too little incentive to encourage increased capital investment;

allowing imputed interest on capital as a cost would not reduce profit in the aggregate; the potential existed for a profit increase through contract negotiations; and instructions governing reward for improved productivity were not clear or comprehensive enough. [Ref. 23] After observing DOD's new profit policy for 18 months, GAO published its report: "Recent Changed in the Defense Department's Profit Policy - Intended Results Not Achieved", on March 8, 1979. [Ref. 24] GAO found that negotiated profit rates increased on a substantial number of DOD contracts because of the new profit policy, specifically due to use of a factor which did not sufficiently offset the amount of imputed interest on capital investment allowed as a cost. GAO's data from 71 negotiations showed 95 percent of prenegotiation profit objective to still be based on cost. GAO stated that the new profit policy lacked sufficient financial incentives and well-defined objectives to encourage defense contractor capital investment in cost-reducing facilities. GAO recommendations for improvement included the following:

- increase emphasis on facilities capital investment;
- further reduce factors of the profit objective which are based on estimated contract costs;
- perform a more detailed analysis of the impact of the new policy on profit rates;
- establish criteria and procedures for use by contract officers in negotiations;
- develop safeguards against negotiated profits higher than objectives; and

- monitor policy implementation to ensure that desired results are being achieved.

In this same timeframe the House Armed Services Committee (HASC) was reporting on its Defense Industrial Base Hearings. The HASC, chaired by Representative Richard Ichord, reported the following findings in a December 31, 1980 report titled, "The Ailing Defense Industrial Base: Unready for Crisis":

- a continuing deterioration and contraction of the defense industrial base;

- lack of a plan for defense industrial base preparedness;

- turbulence in defense system (weapons) programs;

- a shortage of critical materials and a growing dependence on uncertain foreign sources for these materials;

- restrictive procurement policies and procedures;

- tax and profit policies that discourage capital investment;

- diffused responsibility for the condition of the industrial base. [Ref. 25:p. 2-2]

These problems resulted in deterioration of the subcontractor and vendor base with a corresponding decrease in competition.

L. DEFENSE ACQUISITION CIRCULAR 76-23

As a result of GAO's recommendations and its own findings, DOD again revised its profit policy by issuing DAC 76-23 which increased the weight factor for contractor investment in facilities; created separate weight ranges for manufacturing, research and development, and services; and reinstated separate factors for cost and multiple incentives. These policy changes are summarized along with DPC 76-3 changes and policies prior to Profit '76 in Table 1. The Air Force Systems Command assessed the performance of both DPC 76-3 and DAC 76-23 in 1982. That study titled Profit Study '82 [Ref. 26] concluded that defense industry capital investment increased but the increase was still proportionately less than the commercial sector; in spite of DPC 76-3 capital investment as a percentage of total cost did not change during the period 1977-1981; DPC 76-3, although a generally sound concept, needs modification; and DAC 76-23, unless rescinded, will become a greater obstacle to capital investment.

M. DEFENSE FINANCIAL AND INVESTMENT REVIEW

Concerned with the continual inability of the Federal Government to control cost growth, President Reagan formally established the President's Private Sector Survey on Cost Control (PPSSCC) on June 30, 1982. The executive committee chaired by J. Peter Grace and consisting of 161 chairmen and chief executive officers from the country's leading corporations operated under the following charter:

- identify opportunities for increased efficiency and reduced costs achievable by executive action or legislation;

- determine areas where managerial accountability can be enhanced and administrative controls improved;

- suggest short- and long-term managerial operating improvements;

- specify areas where further study can be justified by potential savings;

- provide information and data relating to governmental expenditures; indebtedness, and personnel management. [Ref. 27]

The Grace Commission formed 22 task forces to study specific departments and/or agencies of the executive branch of the Federal Government and 14 task forces to study functions which cut across government. These task forces found that:

- DPC 76-3 and DAC 76-23 did not succeed in increasing levels of capital investment;

- Defense contractors have reached parity with FTC durable goods producers for return on sales;

- Defense contractors maintain better than parity financing as a result of government financing policies;

- DOD contract pricing, profit, and financing policies form an integrated system and should be reviewed as such rather than piecemeal;

- DOD contract pricing, profit, and financing policies should be managed through an integrated data base management information system;

- Using a current interest rate to impute facilities capital cost of money does not accurately reflect cost of money for previously purchased assets. Interest rates used for such calculations should be based on depreciation schedules for previously purchased assets. [Ref. 1:p. V-8]

Based on these and other findings, the Grace Commission recommended that DOD should perform a study of its overall acquisition policy with particular attention given to contract pricing, profit, and financing policies and to the integration of these policies.

In December 1983, the Deputy Secretary of Defense established the Defense Financial and Investment Review (DFAIR) to review the interrelationship of pricing, financing, and profit policies and to make recommendations for their integration. DFAIR compared return on assets (ROA) for 76 defense contractors and durable goods manufacturers (DGM) from 1970-1983. The study group found ROA for DOD business similar to ROA for commercial business of defense contractors and of DGM when 1980-1983 recession period is excluded. They concluded in a June 1985 report that:

- Progress payment policy has been equitable for the period 1970-1983;
- Profit policy does not take into account the cost of working capital;
- Average defense contractor profitability was not unreasonable and decreased slightly for the period 1980-1983 while durable goods manufacturers deteriorated dramatically;
- Profitability of defense contracts has been consistently lower than levels negotiated by contracting officers;
- Foreign military sales (FMS) profits have been greater than DOD work;
- Profits on DOD subcontracts were slightly less than DOD prime contractor work;
- Cost accounting standard (CAS) 414 "Cost of Money" has not increased profit;
- Weighted Guidelines (WGL) need improvement;
- Significant capital investments have been made by defense contractors since Profit '76, however, the increase was driven by factors other than DOD's profit policy; and

- Current profit policy is indifferent to productivity of capital investment and is insufficient to bring about productivity-enhancing improvements [Ref. 1:p. E2].

DFAIR recommended that the overall profit policy be simplified and better integrated with financing policy and length of performance. The level of economic activity which varied greatly during the period of the DFAIR study (1970-1983) is of particular interest. Severe recession caused a dramatic drop in DGM and defense contractor commercial work ROA, while at the same time rapidly decreasing inflation and increased defense spending increased ROA on defense work.

This historical analysis of the DOD systems acquisition process indicates that the same problems continually plague the process: uncontrollable cost growth, inadequate price competition, inadequate incentives to motivate economy and efficiency, inadequate productivity, divergent philosophies on the part of DOD and the Business Community, and unmanageable technical risks associated with new systems acquisition.

III. GOVERNMENT CONTRACTING ENVIRONMENT

This chapter explores the environment in which government agencies contract with corporations for necessary goods and services. The objectives, strategies, and concerns of both the corporation and the government are addressed.

A. CONTRACTOR'S PERSPECTIVE

A popular view of the firm assumes the objective of the firm to be that of maximizing profit. Another view favors earnings per share as the primary goal of the firm. However, maximizing total profit by diluting earnings per share can be deceiving. That is, total profits could be increased by issuing stock and investing the equity capital. Spreading the earnings over a greater number of shares decreases earnings per share. Maximizing earnings per share is an inappropriate goal for two reasons:

> . . . it does not specify the timing or duration of expected returns and . . . it does not consider the risk or uncertainty of the perspective earnings stream. [Ref. 28:p. 6]

The most appropriate objective of the firm is:

> . . . to maximize its value to its shareholders. [Ref. 28: p. 6]

Justification of such an assumption lies in the fact that maximization of the market price of the firm's common stock is a superordinate goal. Van Horne expresses this concept well when he says:

> The market price of a firm's stock represents the value that market participants place on the firm . . . which, in turn, is a reflection of the firm's investment, financing, and dividend decisions. [Ref. 28:p. 6]

In his book, The Management of Innovative Technological Corporations, Simon Ramo characterizes two quantitative objectives of management:

> (1) Management, entrusted with the resources of the owners, seeks to maximize the margin of return over the cost of capital.
>
> (2) Management seeks to maximize the market value of a share of common stock. [Ref. 29:p. 4]

Success, according to Ramo, is measured by how well management makes the necessary trade-offs between these two measurable, quantitative objectives and many nonmeasurable, qualitative objectives. Qualitative objectives include such things as: maintaining technological superiority, satisfying constituents (shareholders, creditors, employees, customers, suppliers, the government, and the public), maintaining growth, financial stability, or achieving competitive advantage in the world market. [Ref. 29:pp. 4-27]

Operation of a corporation, especially a technological corporation, consists of management continually engaging in investment decisions, such as: research and development of new products; market development to improve market share; fixed assets to increase capacity or improve technology; or new sources of supply. The aim of maximizing return on capital and the margin of return over the cost of capital is implemented by setting objectives for the return on each of these investments. Investment decisions are optimized by determining an internal rate of return for each project, assessing the associated risks for each project, and investing in those projects with the highest rate of return commensurate with risk. Risk assessment is typically accomplished by listing risks, assigning probabilities of occurrence, and then evaluating a range of consequences. In this way, the higher probability-of-success projects can compensate for the higher risk projects and the technological corporation can experiment and expand. [Ref. 29:pp. 74-92]

In trying to accomplish its goals, management compensates sources of capital and motivates them to provide more by optimizing its capital structure. The cost of capital is inextricably linked to the stability of earnings. The more unstable its earnings, the higher the interest rate the corporation must offer its creditors. The cost of equity capital, more difficult to quantify, depends on past performance to some degree and anticipated future performance to a larger degree. Technological corporations characteristically experience lengthy periods of research and development and marketing before new products generate earnings. Consequently, purchasers of common stock of technological corporations typically forego immediate dividends for future probable payback. And the market price of the stock is bid up or down commensurate with the expectation of those future returns. Debt financing, in which interest is essentially the cost of capital, is usually cheaper than equity financing because of the tax deductibility of interest. However, debt financing may not be an available option or may be inadvisable because of an excessive debt-equity ratio. The higher the debt-equity ratio, the more the corporation is leveraged and, consequently, the higher the investor's risk. Quarterly and annually, sales revenue, earnings growth, return on assets employed, and return on equity are analyzed by constituents and serve as indicators of management's success in optimizing its objectives. [Ref 29:pp. 30-68]

In addition to the typical corporate strategy portrayed above, the business community is concerned with such other things as: U.S. and world economic trends, the regulatory environment, politics, and societal interests. Government contractors share these overall, business community concerns while simultaneously contending with a host of peculiar concerns. While sheltered, to some degree, from U.S. and world economic trends, government contractors are, to varying degrees, dependent upon the public policy processes of the government. They are very much susceptible to political advocacy. The regulatory environment in which government contractors have to operate, compared to that of their commercial firm counterpart, is substantially greater in magnitude and complexity. And, as evidenced by recent publicity, government agencies, Congress, and the public continually scrutinize every aspect of government contractor operations.

B. GOVERNMENT PERSPECTIVE

Monopsony, the market condition in which there is one buyer and several producers, is the market characteristic of government contracting. The sovereignty of the United States Government gives it powers and immunities not present in private contracting. In this situation government agencies have significant leverage in setting terms, conditions, prices, and profit in contracting for goods and services. However, desiring the continued existence of many producers to foster competition and preserve an industrial base, government agencies try to provide adequate returns. The federal government's policy with regard to profit, stated in the Federal Acquisition Regulations (FAR), is that profit should be sufficient to stimulate efficient contract performance, attract the best capabilities of qualified large and small businesses to government contracts, and maintain a viable industrial base [Ref. 30]. Government contract prices are usually negotiated on the basis of projected costs plus a markup. In the Department of Defense (DOD), this markup is calculated using the Weighted Guidelines (WGL) method which assigns percentage weights to contractor effort, facilities investment, and contractor risk [Ref. 31]. In addition to these considerations, DOD is faced with the task of purchasing, on a competitive basis, a myriad of militarily unique items. As stated in the Defense Financial and Investment Review (DFAIR), these items are typically:

> technologically complex, expensive, produced in low volume, required to be highly reliable and maintainable, long in development, and produced in a regulated market environment. [Ref. 1:p. III-1]

Another aspect of government contracting which makes it unique is its socioeconomic implications: Small Business set-asides, General Agreement on Trade and Tariffs (GATT), Aid to Labor Surplus Areas, etc. Congress, in its capacities as steward of the Treasury and delegator of contracting authority, has administered public policy through government contracting. Budgetary constraints preclude government agencies from taking advantage of exceptional values or multi-year procurements. Although Congress removed some of the impediments with the passage of the 1982 Department of Defense Authorization Act, multi-year procurement is still far from being fully implemented. Consequently, government agencies are frequently forced to forego exceptional buying opportunities or to use marginal contractors. Unknowns in designing "state of the art" weapon systems frequently result in cost overruns. And, because the Freedom of Information Act requires the government to reveal pricing data, the government is less effective than commercial firms in pricing. [Ref. 32]

Recently, there has been increasing concern on the part of Congress, the public, and government agencies about the way the government contracts for its goods and services. The perception has been that the government is inefficient and ineffective in this procurement process. Cost growth and inefficient production rates have been two of the most persistent problems for which DOD has been seeking solutions. The early 1960's were characterized by: highly centralized control exerted by the Office of the Secretary of Defense (OSD) under Secretary McNamara, overreaction to management problems, excessively detailed procedures and regulations, too many paper studies in lieu of physical testing, unrealistic management theories, and frustration on the part of both corporate and military leaders. The result has been a steady increase in the time required to get from full-scale development to initial operational capability. This coupled with unrealistic cost estimating, changes to requirements, and inflation caused the catastrophic cost growth problems of the 1970's.

As early as 1969, Defense Secretary Melvin Laird and his deputy, David Packard, initiated numerous actions to solve these problems as well as to cope with impending budget cuts. In May 1969, Deputy Secretary Packard established the Defense Systems Acquisition Review Council (DSARC) to advise the Secretary of Defense of the status of each major defense system before proceeding from one program phase to the next in its life cycle and to conduct management reviews to determine DOD actions required to improve management of the defense systems acquisition process. In May 1970, Deputy Secretary Packard issued a memorandum delineating his improvement program. This memorandum served as the basis for the July 1971 DOD Directive 5000.1, "Acquisition of Major Defense Systems." The most important feature of this directive was its decentralization of responsibility and authority within DOD for the acquisition of major systems. OSD was given responsibility for establishing acquisition policy and the DOD component departments were given responsibility for identifying needs and developing systems to satisfy their needs.

DOD Directive 5000.1 also initiated policy and procedures to ensure efficient and effective acquisition of major systems. One such procedure was the Development Concept Paper (DCP), which served as a contract between OSD and the DOD component department to determine joint responsibilities for monitoring program progress. The DCP also provided the basic documentation for use by the DSARC in making recommendations to the Secretary of Defense.

In October 1973, the Joint Logistics Commanders issued the Joint Design-to-Cost Guide in response to the need for cost control. In May 1975, Deputy Secretary of Defense, William Clements issued DOD Directive 5000.28, "Design-to-Cost", formalizing the objectives of design-to-cost:

(1) to establish cost as a parameter equal in importance to technical requirements and schedules throughout design, development, production, and operation and

(2) to identify and establish cost elements as management goals for program managers and contractors to achieve the best balance between life-cycle cost, acceptable performance, and schedule. [Ref. 33:p. 77]

In April 1976, the Director, Office of Management and Budget (OMB) issued OMB Circular A-109, "Major Systems Acquisition", which defined major systems acquisition programs for all government agencies. [Ref. 33:pp. 74-82]

In 1981 Deputy Secretary of Defense Frank Carlucci chartered five working groups to review the weapon systems acquisition process and to recommend changes for economy and efficiency. The working groups submitted a combined report on March 31, 1981. On April 30, 1981, after extensive review of the report and input from the service secretaries, Secretary Carlucci issued the "Carlucci Initiatives" which have become known as the Department of Defense (DOD) Acquisition Improvement Program. The Acquisition Improvement Program emphasized improved long-range planning, shorter acquisition schedules, more realistic budgets, reduced cost, and enhanced stability. Without enumerating all 32 initiatives, the most important ones were:

- The Joint Chiefs of Staff, the service secretaries, and the Associate Director of the Office of Management and Budget were added to the membership of the Defense Resources Board (DRB) to assist the Secretary of Defense align weapon systems acquisition with the planning, programming, and budgeting system (PPBS). The role of the DRB was narrowed to consideration of only major issues. Lesser issues were left for Office of the Secretary of Defense (OSD) and service staffs to decide.

- The service secretaries were added to the membership of the Defense Systems Acquisition Review Council (DSARC), the DOD executive committee which reviews major programs at milestones for approval to proceed to the next phase.

- One of the initiatives required the services to document for DSARC that resources exist in the five-year defense program (FYDP) before being allowed to proceed.

- OSD and service secretaries were required to delegate more authority and accountability to program managers.

- Cost thresholds for determining whether a system would be defined as major or not were increased from $100 million to $200 million (FY 80 dollars) in Research, Development, Test, and Evaluation (RDT&E) funds and from $500 million to $1 billion (FY 80 dollars) in procurement funds. Raising these thresholds served to decentralize control thereby providing economy and efficiency.

- Four major changes were implemented with regard to the weapon systems acquisition process. Summarized in Figure 1, they were:

    1. The Mission Element Need Statement (MENS), which documented mission need determination, was replaced with the Justification for Major System New Start (JMSNS), a document normally submitted to the Secretary of Defense (SECDEF) as part of the Program Objective Memorandum (POM). This served to better integrate the acquisition process with PPBS.

    2. The first SECDEF decision point was changed from milestone 0, program initiation, to milestone I, requirement validation. The system concept paper (SCP) replaced the decision coordinating paper (DCP), integrated program summary (IPS), and milestone reference file (MRF) at milestone I as required DSARC documentation. This served to decrease documentation requirements thereby providing greater efficiency.

MILESTONES:	0 PROGRAM INITIATION	I ALTERNATIVE SELECTION	II INTEND TO DEPLOY	III PRODUCTION	
BEFORE		CONCEPT EXPLORATION	DEMONSTRATION/ VALIDATION	FULL SCALE DEVELOPMENT	PRODUCTION/ DEPLOYMENT
	SECDEF DECISION	SECDEF DECISION	SECDEF DECISION	SECDEF DECISION	
DOCUMENTATION:	MENS	DCP IPS MRF	DCP IPS MRF		

		REQUIREMENT VALIDATION	PROGRAM GO-AHEAD		
AFTER	CONCEPT EXPLORATION	DEMONSTRATION/ VALIDATION	FULL-SCALE DEVELOPMENT	PRODUCTION	DEPLOYMENT
	SECDEF MONITORS VIA PPBS	SECDEF DECISION	SECDEF DECISION	SERVICE DECISION	SERVICE REVIEW
DOCUMENTATION:					

Source: [Ref. 34:p. 90]

Figure 1. Before and After DOD Acquisition Improvement Program

3. The second SECDEF decision point was changed from milestone I, alternative selection, to milestone II, program go-ahead.

4. The decision of whether or not to go into production, milestone III, was delegated to the services. [Ref. 34:p. 91]

These changes reduced, from three to two, the number of formal OSD milestone reviews and reduced, from four to two, the number of SECDEF decisions required. This dencentralization and program management emphasis provided by the DOD Acquisition Improvement Program greatly enhanced the economy and efficiency of the weapon systems acquisition process. It also served to reduce the risks faced by both the government and contractors with regard to such things as cost, schedule, performance, producibility, supportability, operability.

IV. THE NATURE OF RISK

This chapter explores the concept of risk. Risks faced by corporations in contracting with the government are examined first. Then, risks which the government bears are looked at. The processes of risk identification, risk estimation, and risk evaluation are addressed in the final section.

A. CONTRACTOR RISK

Malcolm Salter categorizes the job of a corporate general manager into five basic dimensions: supervising current operation, planning for future operation, designing and administering decision-making structures, developing human resources and capabilities, and representing and holding an organization responsible to its various constituencies [Ref. 35:pp. 6-7]. He emphasizes:

> Planning for future operations involves making informed judgements about what opportunities and risks will face the company in the future and identifying alternate means of either exploiting these opportunities or accommodating these risks. [Ref. 35:p. 6]

For government contractors, the uncertainties experienced by all firms, such as: demand for products and services, availability of resources, competition, and economic conditions, are increased. This is because the government is:

> . . . the largest single force in advanced technological development as well as in basic research. [Ref. 29:p. 316]

The Aerospace Industries Association's Risk Elements in Government Contracting, a study which examined key areas of risk in government contracting, identified the following significant risks:

(1) The government, in determining the appropriate type of contract to be used for a given procurement, asks contractors to take risks of a greater magnitude.

(2) Government warranty clauses in contracts for products and services, which are insufficiently defined, proven, or tested, have resulted in a shift of risk to contractors.

(3) Lack of indemnification for ultra hazardous work poses one of the greatest risks government contractors face.

(4) Government agency procurement policies and practices have increased the types and amounts of ordinary and necessary costs of doing business excluded from pricing negotiations; thereby increasing contractor's risk of realizing a reasonable return on investment.

(5) Tendencies on the part of the government and contractors to overoptimistically define and price the effort required to solve technological problems, underrate unknowns, and rationalize abilities to manage potential future problems contribute to cost growth and contractor's risk of return.

(6) Contractors face profit and cost risks in the event of contract termination for the convenience of the government.

(7) Contract revisions due to the government's failure to carefully and realistically assess future allocation of resources results in risk of repeated and costly rearrangement, loss of performance efficiency and reduction in profits.

(8) Beset by funding reduction, contractors assume the risk of not recovering unfunded cost, earnings and termination expenses.

(9) Administrative expense and effort involved in attempting to satisfy what the government might retroactively determine was its requirement for

cost or pricing data coupled with the possibility of a contract price reduction comprise a formidable risk.

(10) Prime contractors, required by the government to certify cost and pricing data of their subcontractors, risk reduced prime contract prices for defective subcontractor data.

(11) Government contracting officers possess unilateral rights of change, termination, and stop work; which, if exercised by a party to a commercial contract, would constitute breach of contract. The corresponding remedy procedures cause uncertainty when controversy occurs. Contractors face risk of selection of wrong forum for dispute, delay, and unrecoverable expenses.

(12) Government policy, directed toward elimination of government facilities ownership, is shifting facilities investment risk to contractors.

(13) There is a risk of the government acquiring rights to precontract inventions in addition to those conceived or first actually reduced to practice in the performance of research and development under government contract.

(14) Contractors face the risk of proprietary data being misused or disclosed by the government.

(15) Government requirements, that contractors furnish data capable of use by others to fabricate identical articles depicted in such data, increase contractors' risk of meeting contractual commitments.

(16) Contractors risk being arbitrarily and unjustly penalized in the source selection process because management systems such as Cost/Schedule Control Systems Criteria are complex, voluminous, and costly.

(17) Legislative requirements, regulations, and administrative controls requiring complete documentation on the part of government contractors increase risks by increasing cost, lessening competition, and increasing changes of default termination and exclusion from future contract awards. [Ref. 13:pp. 6-46]

It should be noted that these concerns, published by the Aerospace Industries Association, are those of corporations engaged in government contract work. This list reflects their own, potentially biased view. Specifically, government contractors are becoming increasingly concerned about the perception that risk is being shifted from the government to the contractor. This concern is valid to the extent that government procurement regulations, policies and practices have, as an objective, shifted risk. However, this says nothing of the appropriateness or fairness of the sharing arrangement. Such a determination is difficult because each contract is handled on an individual basis. The risk-sharing arrangement depends on such things as type of contract, negotiating abilities of both sides, nature of goods and services being contracted for, as well as many other factors. Consequently, even if such arrangements were quantifiable, problems of comparability would remain.

It is also easy to see, looking at this list, why there is such difficulty quantifying government contractor risk, modifying profit measures to reflect that risk, and being able to compare government contractor risk with that of commercial firms.

B. GOVERNMENT RISK

Risks experienced by the government in contracting are the same as those experienced by contractors. The degree to which either party experiences particular risk elements depends on the type of contract which in turn depends on the phase of the acquisition process.

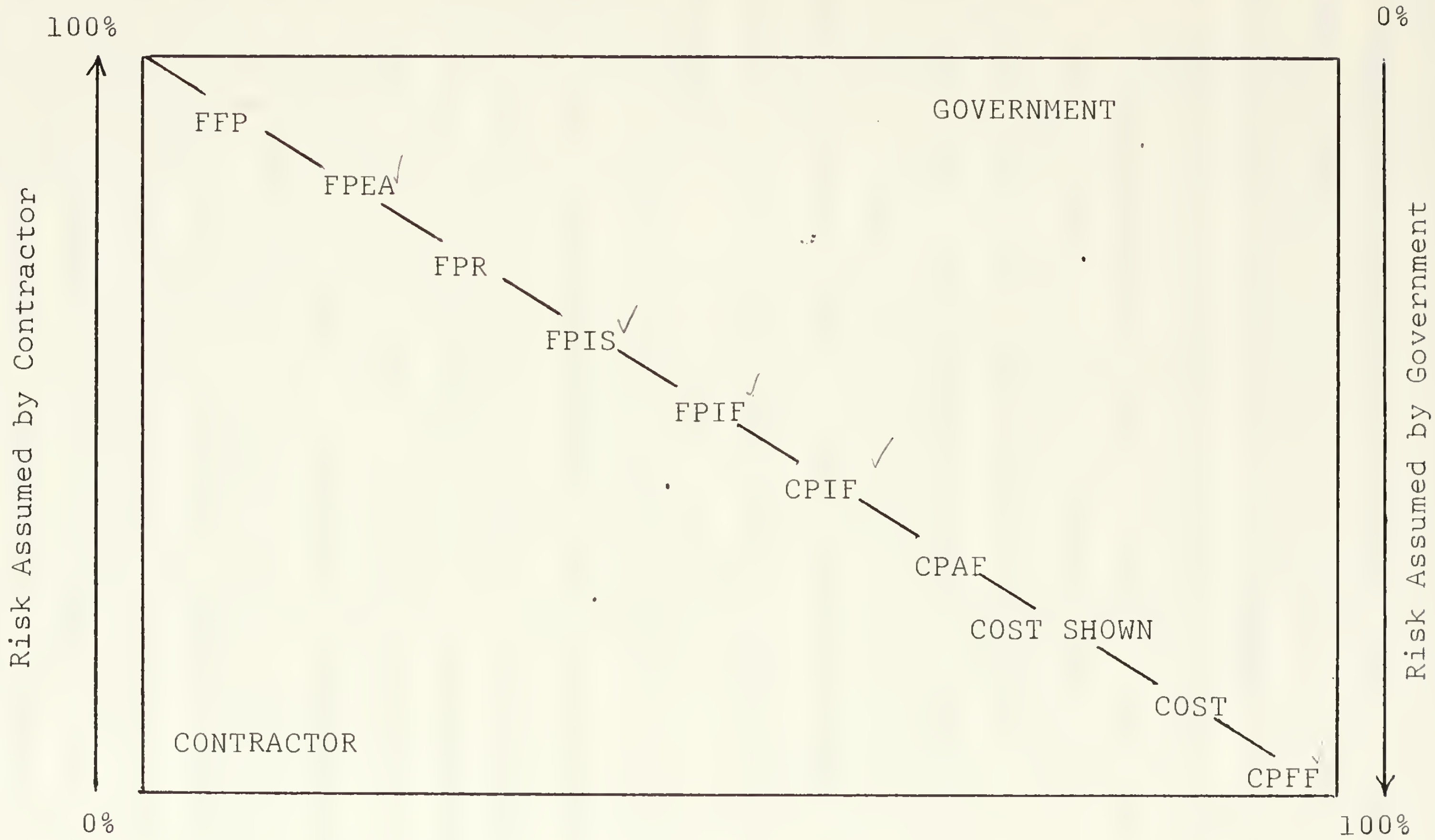
DOD policy dictates that an appropriate contract type be employed commensurate with the circumstances involved in a specific acquisition. The type of contract determines the apportionment of responsibility to both parties and thereby determines the degree of risk each party is to bear. If the contract type selection distributes risk fairly, efficiency and economy will more than likely be achieved. If the apportionment of risk is unfair, then the program will more than likely be disrupted and result in inefficiency and cost overruns. The major motivation for ensuring equitable apportionment of risk is the fact that selection of an inappropriate type of contract invariably results in the program becoming unaffordable, the contract becomes unenforceable, and both parties suffer. Gordon describes this concept best when he says:

> The acquisition of a major weapon system is a mutual undertaking. Both parties commit to mutually reciprocal obligations by way of conduct, financial contribution, and effort. Often these obligations transcend the ability of either party to fully accommodate the consequences of default. For large system acquisitions, the financial risk assumed by the contractor in the event of default almost always exceeds corporate capacity to continue as a viable business entity. Conversely, the government has invested costs, time, effort, lost alternative opportunities, and military commitments. We cannot actually tolerate the financial collapse of a major weapon system developer midway in a program for a variety of political, economic, and military reasons.

Consequently, realistic assessment forces us to conclude that the parties do not expect to enforce the contract literally, despite the hard bargaining exerted to negotiate the express contract and the great importance assigned to our contractual rights and remedies. [Ref. 36:p. 41]

There are two basic types of contracts, fixed price and cost reimbursable. A fixed price contract requires the contractor to produce the goods or perform the services specified for a fixed price. The various forms of fixed price contracts, predicated on the method with which the fee is determined, include: firm fixed price (FFP), fixed price with economic adjustment (FPEA), fixed price redetermination (FPR), fixed price incentive fee (FPIF), and fixed price incentive-successive targets (FPIS). With the cost reimbursable contract, the contractor is required to provide his best effort performance in return for material and labor costs, allowable overhead, and a profit calculated using the weighted guidelines. The various forms of cost reimbursable contracts include: cost, cost plus fixed fee (CPFF), cost plus incentive fee (CPIF), and cost plus award fee (CPAF). Figure 2 shows the degree of risk apportioned as a function of contract type. Fixed price contracts have the potential for apportioning unreasonable risk to contractors, while cost reimbursable contracts have the potential for contractor abuse.

Conventional theory suggests that each phase of the acquisition process has a corresponding contract type which



Source: [Ref. 37:p. 4-24]

Figure 2. Degree of Risk as a Function of Contract Type.

apportions risk appropriately. The fixed price type contract is appropriate for use during the concept exploration phase because it provides a means of putting contractors in a truly competitive position. Typically, what is sought by the government in the concept exploration phase is a response to a Request for Proposal (RFP) which defines a mission need. Therefore, what is being contracted for is a proposal for a system to meet a mission need. Competition, a primary goal during this phase, could be achieved through a number of parallel short-term fixed price contracts. While the potential uncertainties are greater in the demonstration and validation (D&V) phase thereby warranting a cost reimbursement type contract, the desire for continued competition in this phase indicates that contracts should continue to be fixed price in the D&V phase. The full scale development (FSD) phase may require a cost reimbursement type contract because the costs associated with the technical uncertainties in this phase cannot be estimated with any degree of accuracy. This phase calls for the highest degree of flexibility in order to optimize required tradeoffs between cost, schedule, and performance. The CPAF contract in which the fee is determined by evaluation of the product and the contractor at predetermined intervals or at contract completion; the CPIF contract in which the fee is determined according to a formula; or the CPFF contract in which the total cost is known are appropriate for the FSD phase. If pilot production is conducted, a fixed price contract for that subphase would be more appropriate. An FPIF contract would be appropriate for production. Contract type decisions are typically predicated on the maturity of the design and on the judgement of the project manager as to whether design changes will be few or numerous. The government typically favors fixed price contracts because they are easier to administer and they place a higher degree of risk on the contractor. The greatest risk which the government faces is the technical risk involved in designing and eventually producing "state-of-the-art" weapon systems. And, as does the contractor, the government faces risks associated with cost, schedule, and performance.

Many factions within the government have divergent priorities with regard to a major system acquisition. The user wants a superior product delivered as soon as possible and is not usually concerned with cost. Technical people are concerned with enhancing the "state-of-the-art" to the exclusion of cost or schedule. Financial managers are interested in cost control. If any one of these areas are of greater concern than any others to program managers, more restrictive or more explicitly detailed contracts are negotiated with contractors. This serves to shift the risk from the government to the contractor. In order to achieve the lowest possible cost, timely delivery, and maximum technical performance in a major system acquisition, the government must optimize these parameters simultaneously within budget, schedule and specification constraints. Striving for the lowest possible cost, timely delivery, and maximum technical performance, DOD invariably structures contracts inversely proportional to its confidence in attaining these goals. This view is expressed by Gordon:

> The less we expect to be able to gauge and hold down costs, for example, the more rigid we are inclined to structure the pricing matrix of the contract. Although logic would dictate the converse, we instinctively endeavor to make the contract restrictive or most explicit in those areas of greatest risk and/or uncertainty. It is as if we seek to incorporate into the contract that confidence that is fundamentally lacking in the program. [Ref. 36:p. 30]

Cost, normally predictable because of past performance with similar products, becomes a critical risk factor when estimating it on a first time basis in connection with new, high technology products. Previous DOD experience with cost growth serves as evidence of this. Bennett has observed four main reasons for cost growth:

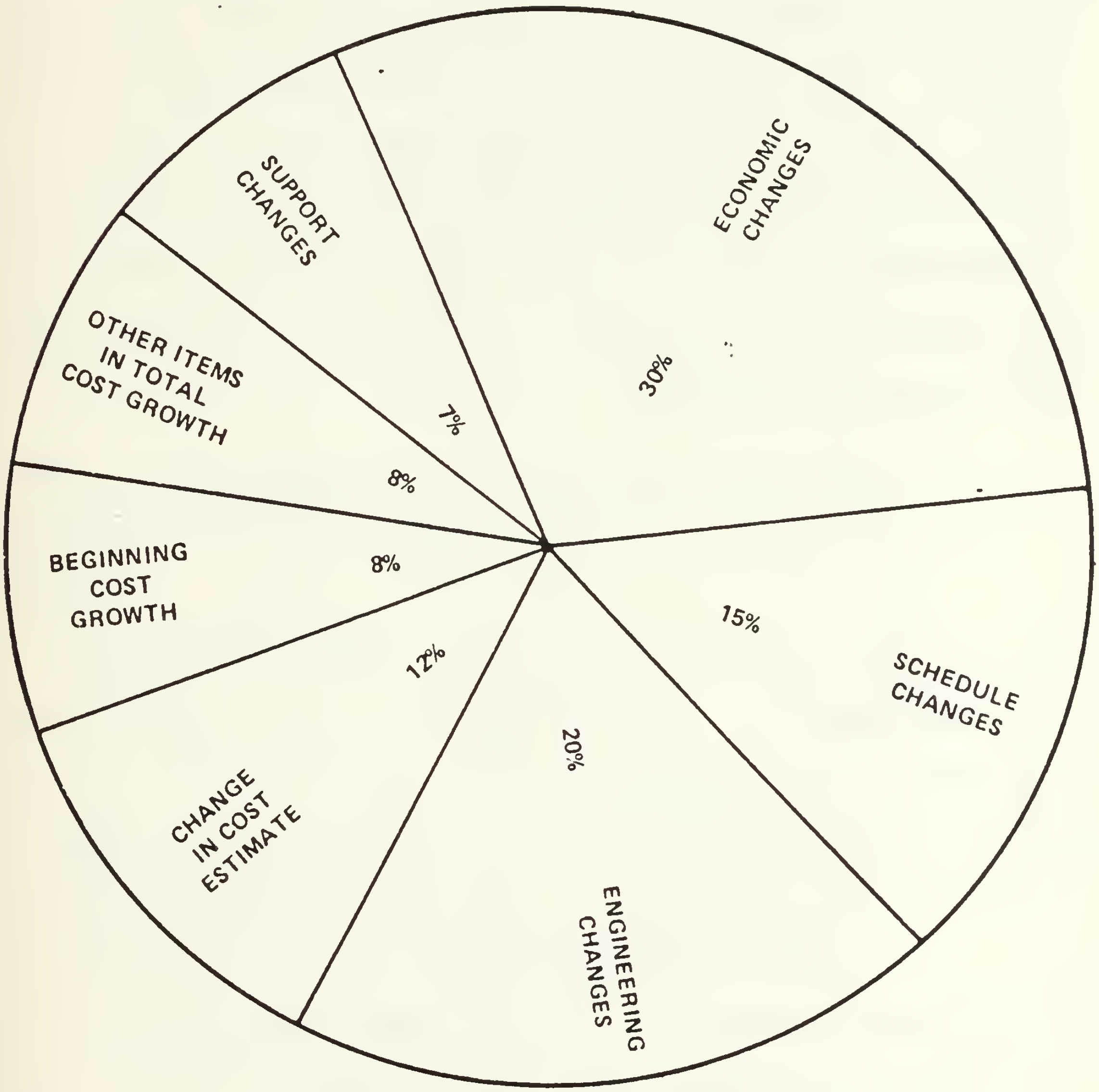
1. Economic inflation, which has affected system costs, is beyond DOD control.

2. Changes in the enemy threat and advancements in military technology cannot be ignored during the systems acquisition life cycle.

3. Using current forecasting methodology and cost-estimating techniques, the cost of new systems can be estimated with no better than 30 percent accuracy.

4. Unknown technical risks plague new major systems throughout most of their development and production cycles. [Ref. 38]

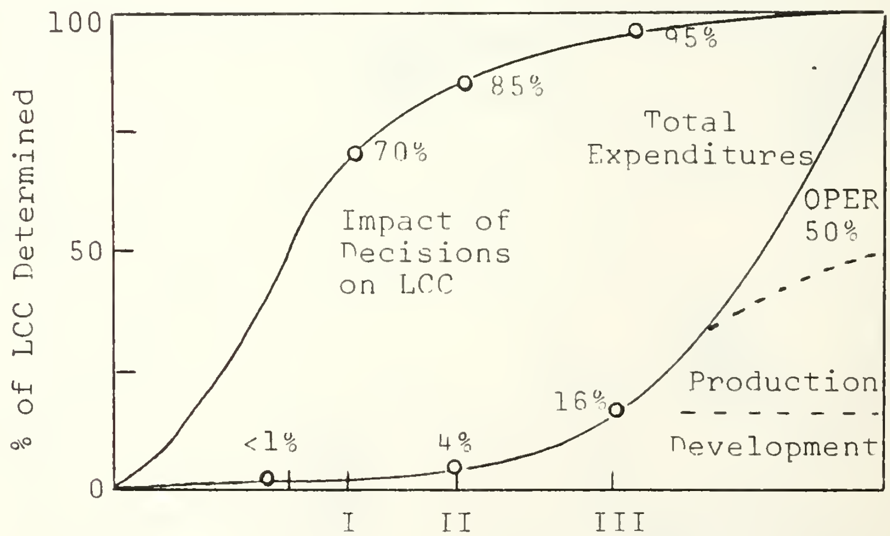
The DOD Manufacturing Management Handbook, after surveying 30 major programs over an extended period of time, found the reasons for cost growth associated with new programs to be those depicted in Figure 3.



Source: [Ref. 25:p. 6-25]

Figure 3. Sources of Cost Growth

Decisions made early in a program determine costs throughout the life of a weapon system. Therefore, from program initiation, life-cycle cost (LCC), the total cost including development, procurement, operation, support, and retirement, is considered together with performance and schedule constraints. As demonstrated in Figure 4, decisions made during the concept exploration phase fix approximately 70 percent of the LCC. Eighty-five percent of the LCC is frozen when only an approximate four percent of expenditures have been made [Ref. 37:p. 1-8]. Because of this effect, concept selection and tradeoffs between cost estimates, performance levels, and schedules become essential in risk assessment.



Source: [Ref. 37:p. 1-8]

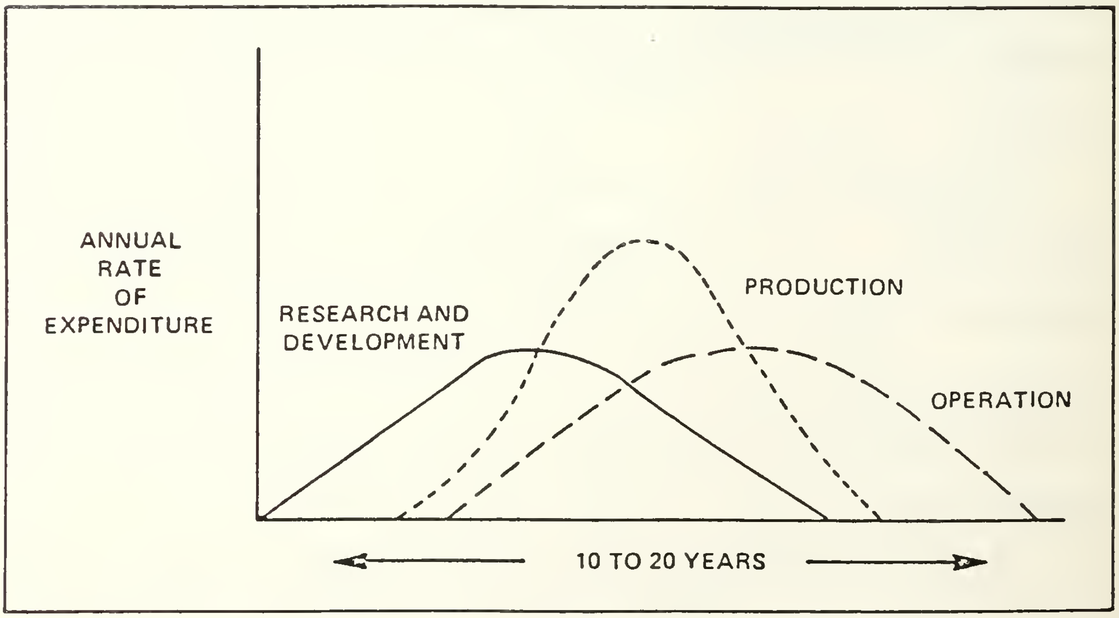
Figure 4. Weapon System Life-Cycle Cost (LCC)

Schedule, normally stable, predictable, and controllable for redundant manufacturing processes, also becomes a major risk factor when initially establishing it for new system development or modifying it as in the case of contractual changes. Production schedules are susceptible to: design stability, funding, specifications, lead time requirements, learning curve, quantity required, system complexity, and whether new system start or off-the-shelf item. Because scheduling involves phasing many elements such as: engineering, production design, parts and material procurement, identification and integration of workers, machine and facility set up, fabrication, assembly, installation, test, quality assurance, and delivery; complete analysis of the manufacturing operation is required. The least little destabilizing influence increases the risk of schedule delays.

Performance, like schedule, is usually set by the program manager. And just like schedule, the performance parameter can be a causative factor in the risk assessment process by virtue of exotic specifications, system sophistication, hazardous components, and/or dealing with a new system start.

Historically, performance was defined by specifications and schedule was established early in the acquisition process. Cost was utilized as a means of assuring that performance specifications were achieved within contractual time constraints. This scenario invariably resulted in funding problems and cost overruns. DOD, realizing that there is always a high degree of uncertainty with regard to cost early in the acquisition process for major system new starts demonstrated in Figure 5, changed its policy. That is, cost, performance, and schedule are now considered to be on equal footing and all are considered flexible. According to the DOD Manufacturing Management Handbook:

> Until new systems are adequately defined and the associated system parameters developed with any degree of confidence, resource and performance projections should be confined to those program objectives associated with current milestone activities. [Ref. 25:p. 6-27]



Source: [Ref. 25:p. 6-26]

Figure 5. Flow of Expenditures in a Typical Weapons System Program

Analysis of government risk indicates that new development is the least attractive alternative available to those concerned with weapon systems acquisition because of the intrinsic cost, schedule, and performance uncertainties. However, since development and maintenance of a superior technological advantage in weapon systems design is one of our highest national strategic goals, risk-avoidance is not a viable option. Program stability, one of the largest factors involved in risk reduction, is, therefore, very important to government risk aversion. Changes in critical system or acquisition process parameters, such as, cost, performance or schedule ripple throughout the program causing disruption, reducing the accuracy of estimates and assumptions, and increasing risk. Major changes can result in devastating results downstream. Operational readiness, logistics support, and life-cycle affordability typically suffer for poor decisions early in a program.

C. RISK ANALYSIS

One conclusion, which repeatedly comes out of the plethora of profitability and risk analyses, is that there is no universally accepted method for analyzing data to assess government contractor risks. A prerequisite to developing such a method would be a formal analysis of the concept of risk.

In attempting to define risk, there is some disagreement between the experts. Knight refers to risk, simplistically, as "measurable uncertainty." [Ref. 39] However, the concept of risk is a complex one. Levy and Sarnat sum up the "essence of risk" most appropriately. They agree that expectations of possible future gains, based on historical data and forecasts of future events, are rarely precise. Consequently, the best that can be expected is:

> an estimate of a range of possible future costs and benefits and the relative chances of earning a high or low profit on investment. [Ref. 40]

Levy and Sarnat distinguish between two states of expectation: certainty and risk (uncertainty). Most definitions of risk include the concept of uncertainty. Rowe characterizes uncertainty as:

> the absence of information about past, present, or future events, values or conditions. [Ref. 41:p. 17]

And he characterizes risk as:

> potential for realization of unwanted, negative consequences for an event. [Ref. 41:p. 24]

Uncertainty, "the absence of information", exists in varying degrees. Therefore, risk analyses must take into consideration the proportion of information which is not known or the "degree of uncertainty." Identifying two types of information, Rowe has categorized two types of uncertainty:

(1) <u>Descriptive Uncertainty</u> - absence of information relating to the identity of the variables that explicitly define a system.

(2) Measurable Uncertainty - absence of information relating to the specification of value assigned to each variable in a system. [Ref. 41:p. 17]

He has also identified three processes common to all systems: human behavior, natural events, and random events. And he asserts that uncertainty can be reduced for both types of uncertainty and all processes with one exception, random measurement uncertainty for future events. He cautions that reduction of uncertainty does not reduce risk. Information gained from reducing uncertainty can be used to control risk, an action which Rowe refers to as "risk aversion."

In trying to construct an anatomy of risk, Rowe, referring to the work of Otway [Ref. 42] and Kates [Ref. 43], utilizes a classification system for risk assessment consisting of three elements:

(1) Risk Identification - qualitative enumeration of all possible risks, involves reduction of descriptive uncertainty.

(2) Risk Estimation - identification of consequences of decisions and estimation of magnitude of risks, involves reduction of measurement uncertainty.

(3) Risk Evaluation - anticipation of the acceptability of risk, involves risk aversion and/or risk acceptance. [Ref. 41:p. 25]

He further divides risk estimation into a five-step process:

(1) Causative Events - probability of event occurrence (p_e)

(2) Outcomes - probability of resultants (p_q)

(3) Exposure - probability of pathway and exposure (p_x)

(4) Consequences - probability of consequence occurrence (p_c). The probability of each consequence p_c is a function of the probabilities of event, outcome, and exposure: $p_c = f_c(P_e, p_q, p_k)$

(5) Consequence Values - range of consequences evaluated by risk agents. Consequence values are a function of consequence definition and probability of consequence occurrence as determined by each risk agent: $C_{ck}(v) = f_{ck}(p_{ck}, C_c)$, where $C_{ck}(v)$ = consequence value determined by risk agent k, and p_{ck} = probability of each consequence determined by risk agent k. [Ref. 41:p. 28]

He concludes that risk estimation (R) is a function of the probability of consequence occurrence and the consequence's value to the risk taker:

$$R = f(p_c, C(v))$$

More specifically, he computes the expected value of risk (EVR) for an undertaking with n consequences as follows:

$$EVR = \Sigma p_n v_n$$

where p_n = the probability of occurrence

v_n = the value of consequences

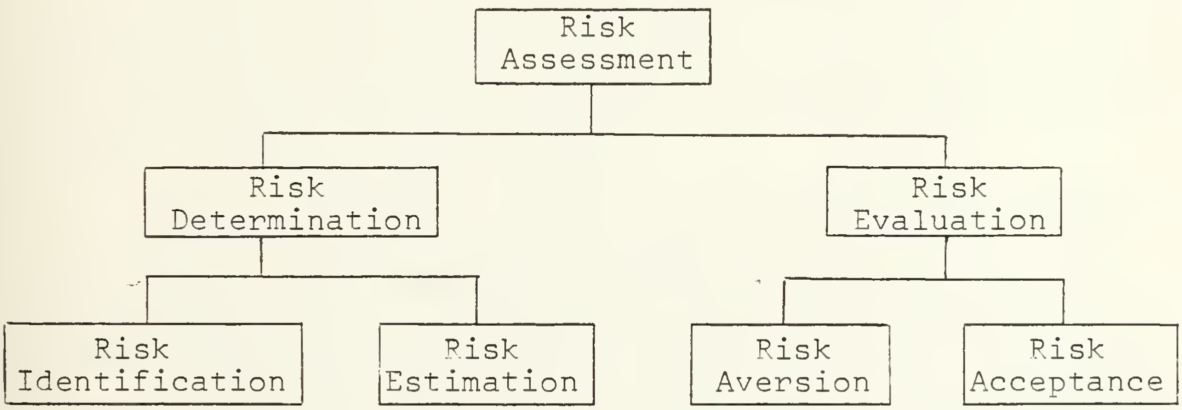
Rowe assumes independence of p_n and v_n which suggests limited application. Stated another way:

> the combination of probability and consequence defines risk. [Ref. 41:p. 39]

Because valuation of consequences by different risk agents involves subjective value judgements, risk estimation is subjective. However, as Rowe points out, experimentation and empirical observation more closely approximate objective risk estimation. Therefore, risk estimation involving a large number of repeated observations should provide a more objective analysis than modeling.

Risk evaluation, involving risk acceptance and/or risk aversion, comprises the second half of the total risk assessment process. Risk acceptance decisions are subjective. If the risk under consideration is below an arbitrarily determined level, it is considered acceptable. If a risk is unacceptable then risk aversion, the action taken to reduce risk, could take the form of risk avoidance, reduced exposure to risk, or control of causative events. [Ref. 41:p. 44]

Therefore, the anatomy of risk, as developed by Rowe, consists of those elements depicted in hierarchal order in Figure 6:



Source: [Ref. 41:p. 45]

Figure 6. Anatomy of Risk

Methods of risk estimation and risk evaluation are many and varied. However, for technological corporations, there are two main categories of risk to consider: business risk and financial risk. Finnerty categorizes as business risks all risks which affect all businesses: technical risks, bidding risks, production risks, cost risks, government action risks, and commercial market risks. He categorizes as financial risk: the risk of bankruptcy and the risk of return. He contends that both financial risk and business risk reflect the impact of a company's operating decisions. However, only financial risk reflects the impact of a company's financial decisions. Consequently, he concludes, financial risk, measured as the coefficient of variation of net income, is an all-inclusive reflection of a company's overall uncertainty. [Ref. 44]

V. EMPIRICAL ANALYSIS

This chapter presents the empirical analysis and the implications of the findings. Four methods are investigated: mean-variance analysis of returns on net worth; capital asset pricing model; mean-variance analysis of backlog; and mean variance analysis of five-year defense program elements.

A. MEAN-VARIANCE ANALYSIS OF RATE OF RETURN

1. Methodology

Expanding the analysis performed in the thesis titled "DOD Contractor Profitability 1980-1984" [Ref. 45], this study seeks to analyze defense industry risk versus that experienced by the commercial sector and the relationship between risk and return. Financial performance data was collected from SEC 10K Reports and applied to Morse and Kramer's sample of 49 companies. The resulting sample data were used to analyze contractor risk utilizing mean-variance analysis of return on net worth.

Morse and Kramer derived their sample of 49 companies, representing a broad cross-section and including principal industry groupings, by identifying which companies appeared in the DOD publication, 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards [Ref. 46], in each of the five years, 1980-1984. They disregarded the relative position of each company in the reports as well as the proportion of DOD sales to total sales in sample selection. However, they did use the proportion of DOD sales to total sales to segregate two additional comparative subsamples: 36 commercially-oriented firms and 13 DOD-oriented firms. Thirty percent DOD sales was chosen as the division criterion because a clear break in the distribution of percent DOD sales over time occurred at that point. The 36 commercially-oriented firms had less than 30 percent DOD sales and the 13 DOD-oriented firms had greater than 30 percent DOD sales. Tables (2), (3), and (4) list these samples of 49, 36, and 13, respectively.

After sample selection, it was necessary to consider an appropriate profit measure. Accountants and economists hold widely differing views of the meaning of profit. Profit, as interpreted by an accountant, is simply the difference between revenues and costs, synonymous with net income [Ref. 47]. Economists, on the other hand, define profit more narrowly. They are concerned with opportunity costs, the value that could be produced if the required resources were used to produce other outputs. Consequently, economic profit is what remains after all explicit and implicit costs for wages, rent, and interest are paid [Ref. 48]. Because accounting profit includes economic profit and is less complex, it was selected. Accounting profit,

TABLE 2

SAMPLE OF 49 GOVERNMENT CONTRACTORS

Company	NYSE Symbol	Company	NYSE Symbol
Allied Corporation	ALD	Atlantic Richfield Co.	ARC
AVCO Corporation	AV	Boeing Company	BA
Chevron Corporation	CHV	Coastal Corporation	CGP
Control Data Corporation	CDA	E-Systems, Inc.	ESY
Emerson Electric Co.	EMR	EXXON Corporation	XON
FMC Corporation	FMC	Fairchild Industries, Inc.	FEN
Ford Motor Company	F	General Dynamics Corporation	GD
General Electric Company	GE	General Motors Corporation	GM
Goodyear Tire & Rubber Co.	GT	Gould, Inc.	GLD
Grumman Corporation	GQ	Harris Corporation	HRS
Hercules, Inc.	HPC	Honeywell, Inc.	HON
ITT Corporation	ITT	International Business Machines	IBM
Litton Industries, Inc.	LIT	Lockheed Corporation	LK
Martin Marietta Corporation	ML	McDonnell Douglas Corporation	ML
Mobil Corporation	MOB	Morton Thiokol, Inc.	MTI
Motorola, Inc.	MOT	Northrop Corporation	NOC
Penn Central Corporation	PC	RCA Corporation	RCA
Raytheon Company	RTN	Reynolds (R.J.) Industries, Inc.	RJR
Rockwell International Corp.	ROK	Royal Dutch Petroleum Company	RD
Sanders Associates, Inc.	SAA	The Signal Companies, Inc.	SGN
Singer Company	SMF	Sperry Corporation	SY
TRW Inc.	TRW	Teledyne, Inc.	TDY
Tenneco, Inc.	TGT	Textron, Inc.	TXT
Todd Shipyards Corp.	TOD	United Technologies Corporation	UTX
Westinghouse Electric Corp.	WX		

TABLE 3

SAMPLE OF 36 COMMERCIALLY-ORIENTED CONTRACTORS

Company	NYSE Symbol	Company	NYSE Symbol
Allied Corporation	ALD	Atlantic Richfield Co.	ARC
AVCO Corporation	AV	Chevron Corporation	CHV
Coastal Corporation	CGP	Control Data Corporation	CDA
E-Systems, Inc.	ESY	Emerson Electric Co.	EMR
EXXON Corporation	XON	Fairchild Industries, Inc.	FEN
Ford Motor Company	F	General Electric Company	GE
General Motors Corporation	GM	Goodyear Tire & Rubber Co.	GT
Gould, Inc.	GLD	Harris Corporation	HRS
Hercules, Inc.	HPC	Honeywell, Inc.	HON
ITT Corporation	ITT	International Business Machines	IBM
Mobil Corporation	MOB	Morton Thiokol, Inc.	MTI
Motorola, Inc.	MOT	Penn Central Corporation	PC
RCA Corporation	RCA	Reynolds (R.J.) Industries, Inc.	RJR
Royal Dutch Petroleum Co.	RD	The Signal Companies, Inc.	SGN
Singer Company	SMF	Sperry Corporation	SY
TRW Inc.	TRW	Teledyne, Inc.	TDY
Tenneco, Inc.	TGT	Textron, Inc.	TXT
Todd Shipyards Corp.	TOD	Westinghouse Electric Corp.	WX

TABLE 4

SAMPLE OF 13 DOD-ORIENTED CONTRACTORS

Company	NYSE Symbol	Company	NYSE Symbol
Boeing Company	BA	FMC Corporation	FMC
General Dynamics Corp.	GD	Grumman Corporation	GQ
Litton Industries Inc.	LIT	Lockheed Corporation	LK
Martin Marietta Corp.	ML	McDonnell Douglas Corp.	MD
Northrop Corp.	NOC	Raytheon Company	RTN
Rockwell International Corp.	ROK	Sanders Associates, Inc.	SAA
United Technologies Corp.	UTX		

synonymous with net income, is usually expressed as a percentage of a selected base: sales, assets, or capital. Return on sales does not measure the resources which generate profit. Return on assets does not measure whether owners receive returns commensurate with risk. Return on net worth reflects stockholders equity; consequently, it was considered the most appropriate measure. Therefore, profit was measured utilizing the rate of return on net worth, synonymous with rate of return on common shareholders' equity (ROE) calculated as follows:

$$\text{ROE} = \frac{\text{Net income after taxes}}{\text{capital stock + surplus + retained earnings}}$$

The relationship between risk and return is a complex one, as evidenced by the paucity of empirical analyses in this area. Fisher and Hall offer two possible reasons for this paucity:

> . . . there are two reasons for this neglect. One relates to policy-uses of such investigation, the other to the required theoretical assumptions. [Ref. 9:p. 26]

They go on to explain that in the unregulated sector of the economy, profit policy is focused on preserving competition to ensure that profits are appropriate. And, in the regulated sector, they contend that profits are set as an ex ante component of price, which is negotiated rather than set competitively. Therefore, they conclude, regulators and regulated firms are more interested in analyses of the comparability of government contract profits with those of commercial firms and industries. The second reason given by Fisher and Hall, the required theoretical assumptions, is explained as follows:

> The difficulty is that it is impossible to observe anticipations. . . . the assumption required to handle anticipation may well have discouraged empirical investigation. [Ref. 9:p. 26]

They suggest that this problem can be overcome by using a proxy for the expected rate of return. Fisher and Hall chose a definition of risk that is based on the deviation of company rates of return from their own mean:

> For a firm already in some line of commerce, intraindustry dispersion is not a good measure of risk. If the industry group has diverse but temporally stable rates of return, the firm's own history will provide a better basis for measuring its risk exposure. If the rates of the group members are similar, presumably the firm will be concerned not with how well it is going to do relative to its rival, but with how stable its future profits will be. [Ref. 9:p. 32]

The company-mean standard deviation to which they refer is computed as follows:

$$\sigma_i = \left[\frac{\sum_{t=1}^{n} (r_{it} - \bar{r}_i)^2}{n-1} \right]^{\frac{1}{2}}$$

where σ_i = standard deviation of rates of return about the average for firm i;

r_{it} = rate of return in period t for firm i;

$\bar{r}_i$ = average rate of return over the period for firm i;

n = number of years included in the period.

Utilizing Fisher and Hall's measure of risk, this study investigated the statistical correlation between each firm's risk exposure and average rate of return for the 49 firms in Morse and Kramer's sample for the period 1976 to 1984. Sample data is contained in Table 6 of Appendix A. A firm's average rate of return can be expressed as the sum of an average risk-adjusted rate of return, r_o, and a risk premium which compensates the firm for greater earnings variability, i.e., risk exposure, $b\sigma_i$:

$$\bar{r}_i = r_o + b\sigma_i$$

where $\bar{r}_i$ = average rate of return for firm i;

r_o = average risk-adjusted rate of return for all firms;

σ_i = standard deviation of rates of return about the average for firm i;

b = marginal rate of profit per increment of dispersion (slope of regression line)

2. Analysis

Figure 7, a scatter diagram of the 49 firms plotted mean versus standard deviation, graphically shows the relationship between mean return on net worth and the dispersion of those returns.

a. Sample of 49 Contractors

Sample data for the 49 firms was regressed as follows: The data, plotted average rate of return on net

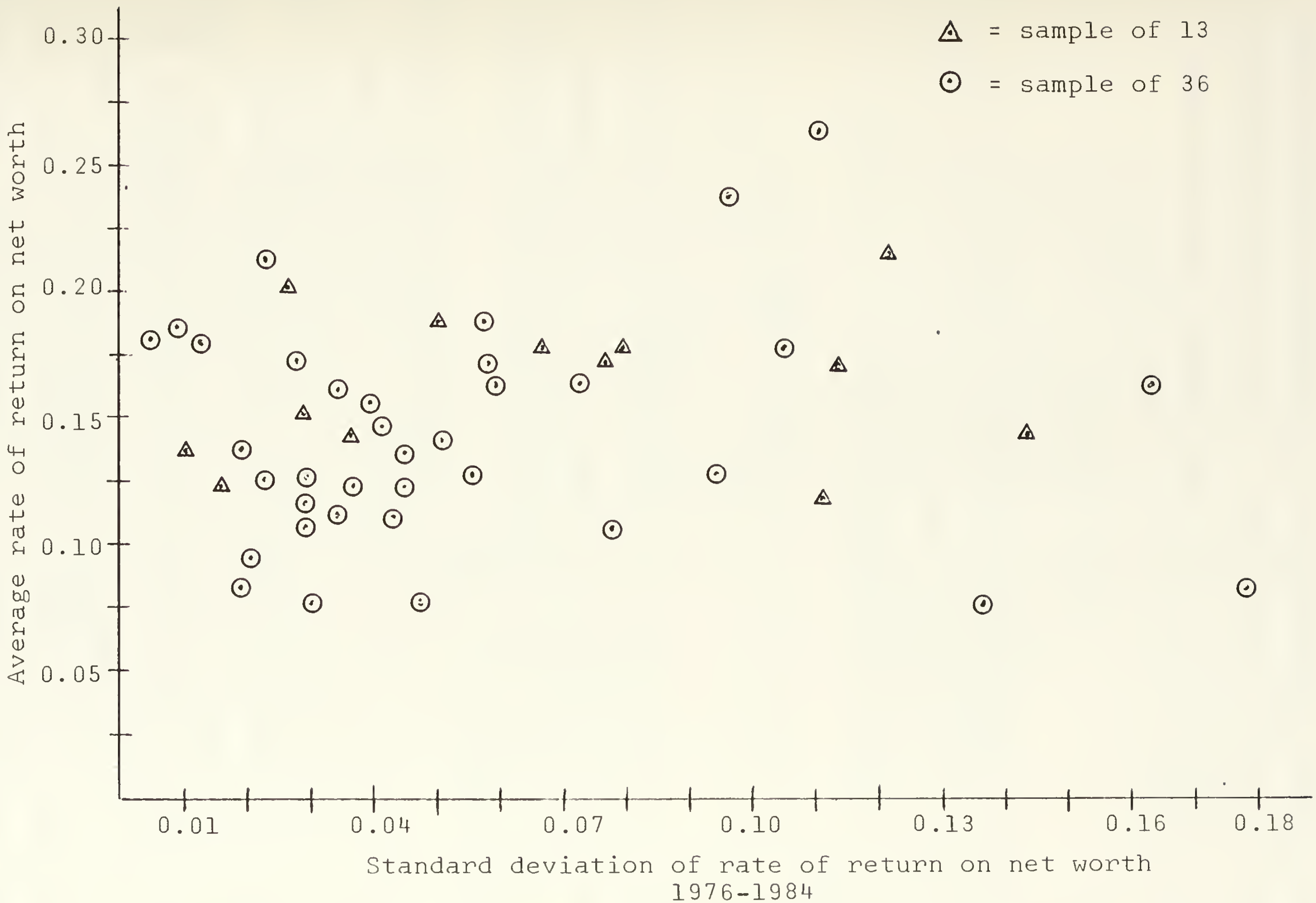


Figure 7. Scatter Diagram of Rate of Return versus Standard Deviation

worth versus standard deviation of rate of return on net worth 1976-1984 for 49 firms, yields a close approximation to a straight line. This would indicate that the data can be approximated by an equation of the form:

$$\bar{r}_i = r_o + b\sigma_i$$

Using the observed data contained in Appendix A of this study to estimate the parameters r_o and b of the regression line resulted in the following values for the sample of 49 firms:

$$\bar{r}_i = 0.149 + \underset{(0.289)}{0.017}\sigma_i, \qquad R^2 = 0.017$$

std error of b

The value of R^2 for the sample of 49 firms is extremely low which would indicate that there is no linear correlation between average rate of return and the standard deviation for the sample of 49 firms.

Of the tests of hypotheses concerning regression coefficients r_o and b, those concerning the coefficient b are important because b is the slope of the regression line. The coefficient b is also the change in the mean of the rates of return on net worth corresponding to a unit change in standard deviation of rate of return on net worth. If $b = 0$, the regression line would be horizontal and would indicate that the mean of the rates of return on net worth does not depend linearly on standard deviation. Therefore, testing the null hypothesis $b = 0$ against the alternative hypothesis $b \neq 0$, where b is the parameter to be estimated, at the 0.05 level of significance yielded the following:

Null Hypothesis: $b = 0$

Alternative Hypothesis: $b \neq 0$

Level of Significance: $\alpha = 0.05$

Criterion: Reject the null hypothesis

if $-t_{\alpha/2} > t > t_{\alpha/2}$

with n-2 degrees of freedom

$$t = \frac{(\hat{b}-b)}{Se} \left[\frac{Sxx}{n} \right]^{\frac{1}{2}}$$

where,
$$Se = \left[\frac{SxxSyy - (Sxy)^2}{n(n-2)\ Sxx} \right]^{\frac{1}{2}}$$

$$Sxx = n \sum_{i=1}^{n} \sigma_i^2 - \left[\sum_{i=1}^{n} \sigma_i \right]$$

$$Syy = \sum_{i=1}^{n} r_i^2 - \left[\sum_{i=1}^{n} r_i \right]^2$$

$$Sxy = n \sum_{i=1}^{n} \sigma_i r_i - \left[\sum_{i=1}^{n} \sigma_i \right] \left[\sum_{i=1}^{n} r_i \right]$$

For the sample of 49 firms the computed t is:

$$t = \frac{(0.017 - 0)}{0.043} \left[\frac{4.18}{49} \right]^{\frac{1}{2}}$$

$$t = 0.115$$

and the critical t is:

$$t_{0.025} = 1.96$$

Since $t = 0.115 \not> t_{0.025} = 1.96$

and $t = 0.115 \not< -t_{0.025} = -1.96$,

we cannot reject the null hypothesis. Therefore, we conclude that the coefficient b is not significantly different from zero at the 0.05 level for the sample of 49 firms. We also conclude that there does not appear to be a linear relationship between the average rate of return for the sample of 49 firms and the standard deviation of the rates of return about the mean.

b. Sample of 36 Commercially-Oriented Firms

Similarly, sample data for the 36 commercially-oriented firms, also contained in Appendix A of this study, were regressed resulting in the following values:

$$\bar{r}_i = 0.137 + \underset{(0.343)}{0.057}\sigma_i, \qquad R^2 = 0.034$$

std error of b

The value of R^2 for the sample of 36 firms is also extremely low, indicating no linear correlation.

For the sample of 36 commercially-oriented firms the computed t is:

$$t = 0.325$$

and the critical t is:

$$t_{0.025} = 1.96$$

Since $t = 0.325 \ngtr t_{0.025} = 1.96$

and $t = 0.325 \nless -t_{0.025} = -1.96$,

we cannot reject the null hypothesis. Therefore, we conclude for the sample of 36 commercially-oriented firms that the coefficient b is not statistically significant at the 0.05 level. There appears to be no linear relationship between the average rate of return and standard deviation for the sample of 36 commercially-oriented firms as well.

c. Sample of 13 DOD-Oriented Firms

Sample data for the 13 DOD-oriented firms, exhibited in Appendix A, were regressed resulting in the following values:

$$\bar{r}_i = 0.137 + \underset{(0.290)}{0.333}\sigma_i, \qquad R^2 = 0.563$$

std error of b

The value of R^2 for the sample of 13 DOD-oriented firms is of such a size as to be considered useful for group type predictions. This indicates that there is a positive linear correlation between the variables regressed.

For the sample of 13 DOD-oriented firms the computed t is:

$$t = 2.53$$

and the critical t is:

$$t_{0.025} = 2.20$$

Since $t = 2.53 > t_{0.025} = 2.20$

we can reject the null hypothesis. Therefore, we conclude for the sample of 13 DOD-oriented firms that the coefficient b is statistically significant at the 0.05 level. We also conclude that a linear relationship exists between the average rate of return and standard deviation for the sample of 13 DOD-oriented firms.

3. Results

Statistical findings are summarized as follows:

Sample of 49 firms:

$$\bar{r}_i = 0.149 + \underset{(0.289)}{0.017}\sigma_i, \qquad R^2 = 0.017$$

std error of b

Sample of 36 commercially-oriented firms:

$$\bar{r}_i = 0.137 + \underset{(0.343)}{0.057}\sigma_i, \qquad R^2 = 0.034$$

std error of b

Sample of 13 DOD-oriented firms:

$$\bar{r}_i = 0.137 + \underset{(0.290)}{0.333}\sigma_i, \qquad R^2 = 0.563$$

std error of b

The resulting low values of R^2, high standard errors of the coefficient b, and finding that the coefficient b is not statistically significant, for the sample of 49 firms and the sample of 36 commercially-oriented firms, were contrary to a priori expectations. However, the signs of the coefficients for all three samples were as expected, that is, positive. The value of R^2 for the sample of 13 DOD-oriented firms was sizeable enough to be considered useful. Although the coefficient b was found to be statistically significant for the sample of 13 DOD-oriented firms, its standard error was found to be sizeable.

Because the b coefficients for the sample of 49 firms and the sample of 36 commercially-oriented firms were not statistically significant, no inferences can be made regarding comparability of risk premiums, $b\sigma_i$.

The statistical significance of the coefficient b for the 13 DOD-oriented firms supports the a priori expectation that σ, the standard deviation of rates of return, is an appropriate measure of total risk. The finding that the coefficients for the 49 firms and the 36 commercially-oriented firms were not statistically significant weakens the inference but by no means disproves the hypothesis.

The positive sign of the coefficient b obtained for all three samples supports the theory that firms require larger expected rates of return given increased uncertainty of potential earnings.

The value of R^2 for the 13 DOD-oriented firms was sizeable enough to indicate that there is a linear relationship between the average rate of return and the measure of risk, σ. However, the low value of R^2 for the 49 firms and the 36 commercially-oriented firms suggests that there are factors other than risk which account for the observed differences in rates of return.

In their December 1967 study, Risk and the Aerospace Rate of Return, Fisher and Hall investigated some of the factors which they believed accounted for the difference in rates of return. They state:

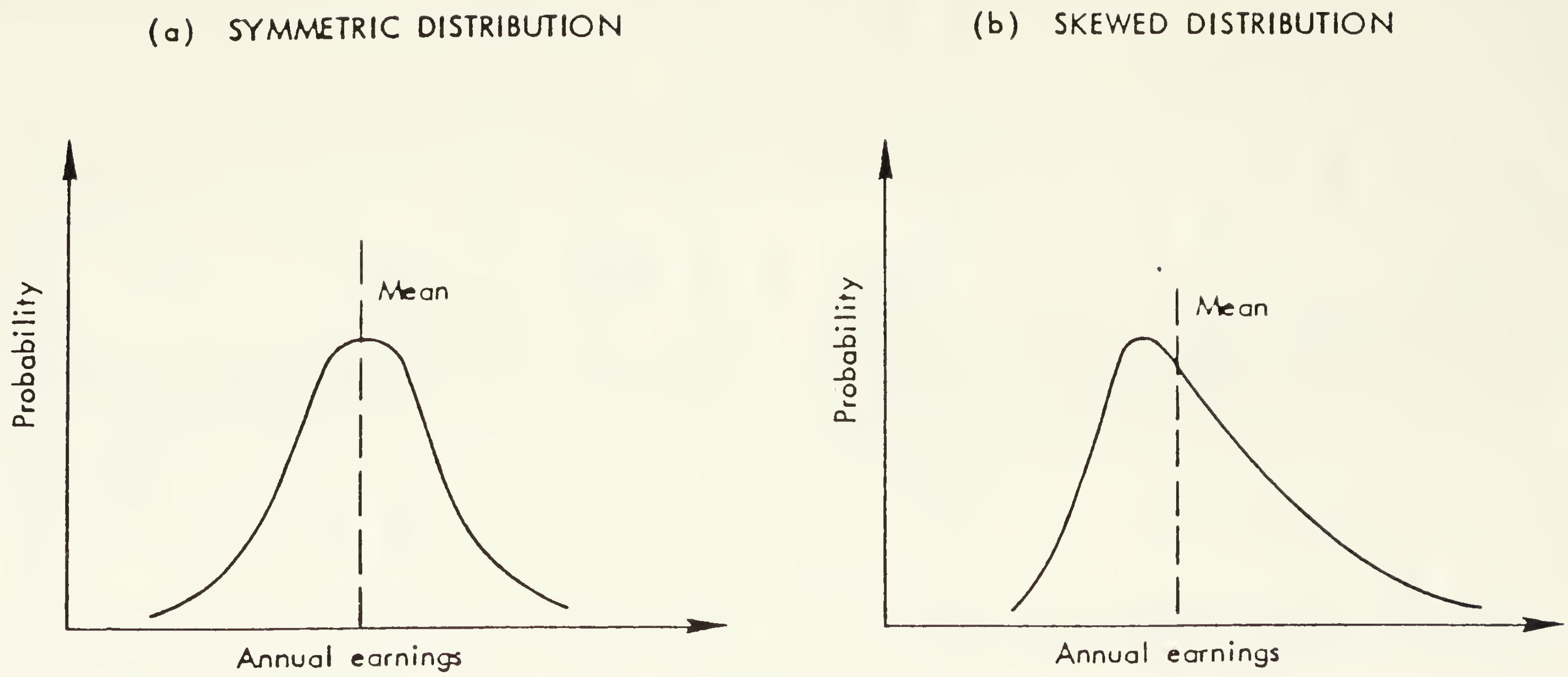
> Dispersion is only one characteristic of the probability distribution of earnings; skewness is another that may help explain the observed differences. [Ref. 9:p. 39]

They tested their hypothesis that risk premiums may be lower for firms with skewed earnings distributions by including a measure of skewness into their model. Figure 8 depicts the difference between symmetric and skewed distribution. The addition of a skewness measure increased R^2 only slightly and resulted in a coefficient of skewness that was not statistically significant. Those results would suggest that skewness did not account for any portion of the differences in rates of return. However, they also found that skewness became significant after adjustments were made for trend, autocorrelation, and industry membership.

Fisher and Hall further suggested:

> In part this low correlation between rate of return and risk may be due to the influence of broad industry effects. Differences among industries in market structure, technology, average managerial ability, capital structure, and similar factors could produce industry differentials. [Ref. 9:p. 39]

To adjust their model for industry membership they introduced a set of dummy variables for 11 industry groups into



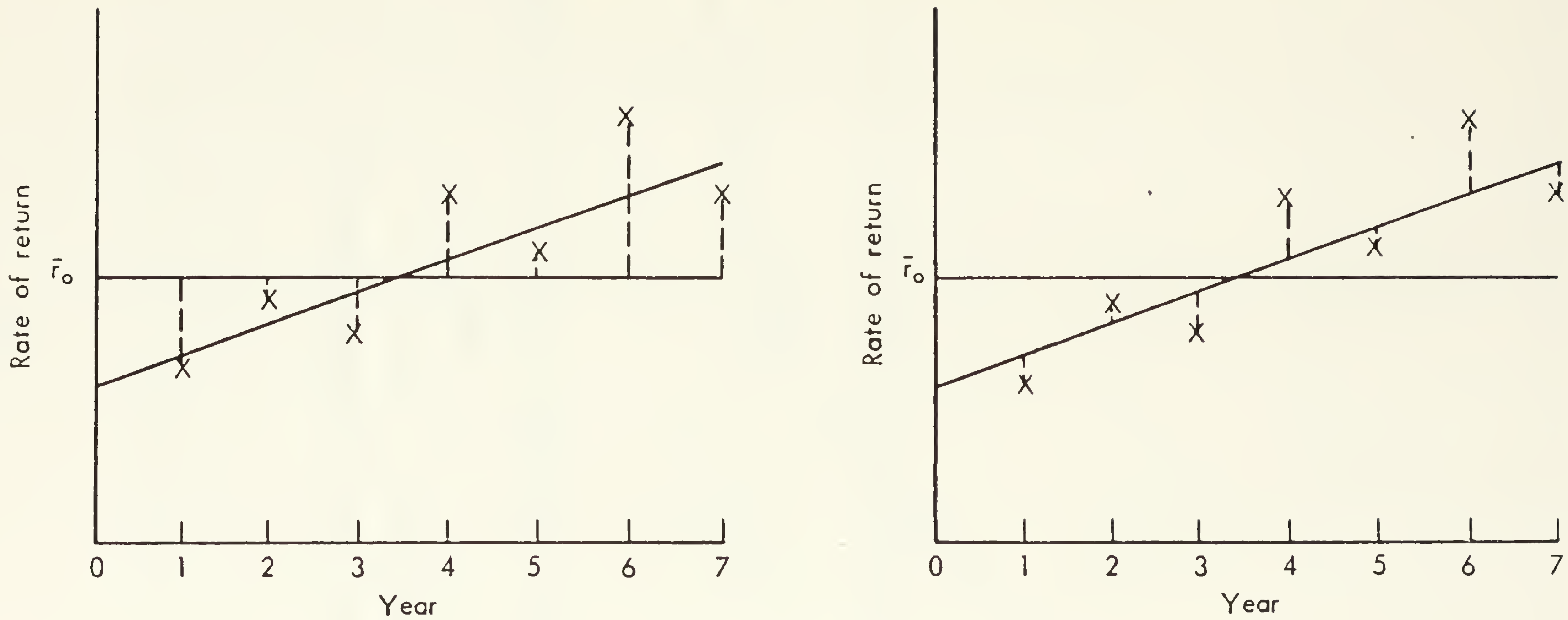
Source: [Ref. 9:p. 40]

Figure 8. Symmetric and Skewed Distributions of Firm's Earnings

the equation to relate each company's rate of return to its risk exposure. The effect of a dummy variable is to shift the vertical axis intercept of the regression line upward or downward. Using the dummy variable method does not permit a different risk coefficient, b, for each industry. However, it does provide an average risk-adjusted rate of return for each industry. Fisher and Hall's adjustment to their model for industry membership resulted in a substantially increased value of R^2.

Fisher and Hall also identified that some of what was appearing as earnings variability was actually the result of time trend. They contend that measurement of deviation about the mean results in a larger deviation than if the measurement were deviation about the trend. This can be seen in Figure 9. To remove this effect, they developed an alternative measure of risk, σ_i^t, and substituted it into their model. For most industries the risk-adjusted rates of return changed little after eliminating the trend effect. However, the aerospace industry, the major supplier of DOD goods and services, was one industry, which did show significantly larger average risk-adjusted rates of return after eliminating the trend.

Another effect which Fisher and Hall investigated was that of autocorrelation, the correlation of a variable with itself over time. This effect is displayed in Figure 10. They corrected for this effect by: testing for autocorrelation using the Durbin-Watson statistic, D; identifying

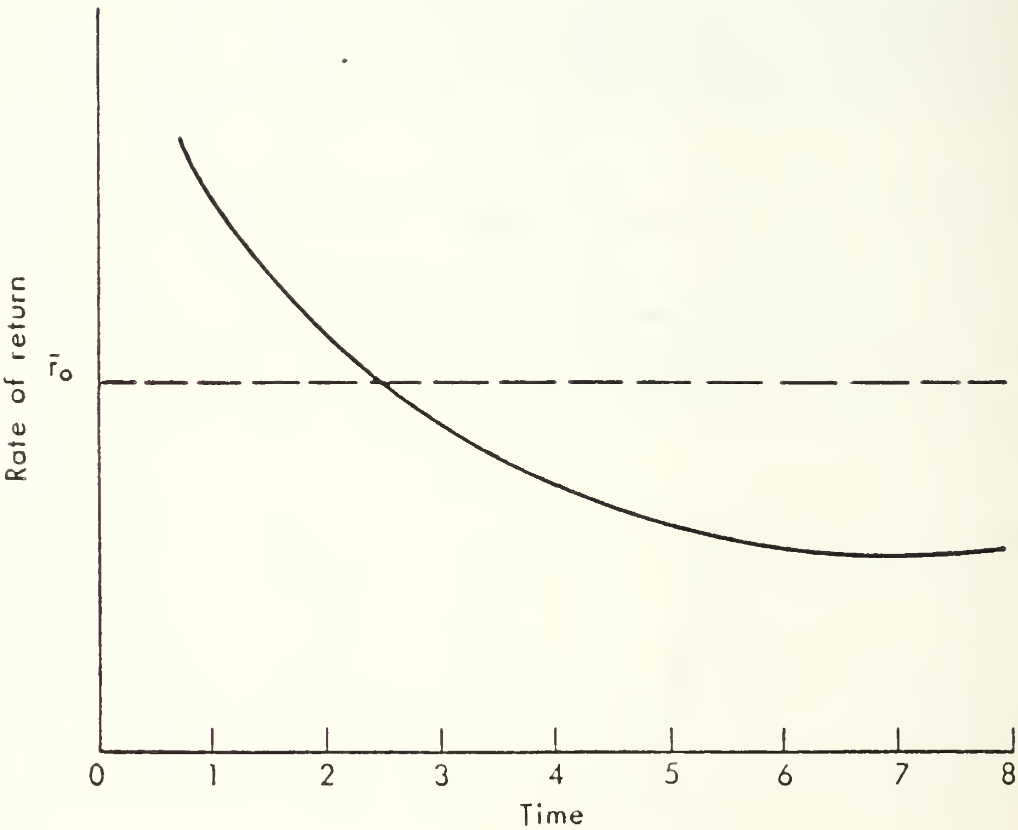


(a) Deviations about average, $\bar{r}_o$

(b) Deviations about trend

Source: [Ref. 9:p. 42]

Figure 9. Measurement of Deviations about Means and Trend



Source: [Ref. 9:p. 44]

Figure 10. Autocorrelated Earnings

those firms that exhibited positive serial correlation for rate of return; and removing autocorrelated firms from the sample. The result of removing autocorrelated firms was increased risk-adjusted rates of return for those industries.

The final form of the Fisher and Hall model is as follows:

$$\bar{r}_{ij} = b_1\, \sigma^t_{ij} + b_2\, S^t_{ij} + c_j$$

where, $\bar{r}_{ij}$ = average rate of return for firm i in industry j,

σ^t_{ij} = standard deviation of rates of return about the trend for firm i in industry j,

s^t_{ij} = measure of skewness of rates of return about the trend for firms in industry j,

c_j = dummy variable for industry j, the risk adjusted rate of return for industry j.

The Fisher and Hall study demonstrated that risk significantly affects average industry rates of return provided adjustments were made to the model. Their study also suggests that the model is somewhat flexible with regard to which variables or adjustments are included. It also suggests that similar adjustments for skewness, industry membership, trend effects, and autocorrelation to the model used in this thesis would result in statistically significant regression coefficients and increased correlation coefficients.

Gloria Hurdle, in her November 1974 study, "Leverage, Risk, Market Structure and Profitability", developed a three-simultaneous-equation multiple regression model to analyze the relationships among leverage, market structure, risk and profitability. The three equations and the variables she chose to estimate, with expected signs indicated, are as follows:

Risk Equation

$$\sigma = \text{CONSTANT} - M - ADV - ASSET - GROUP + K/Y + DEBT + DV$$

Debt Equation

$$DEBT = \text{CONSTANT} \pm M + GROW \pm GROUP \pm \pi - \sigma + ASSETS + K/Y$$

Profit Equation

$$\pi = \text{CONSTANT} + M + ADV \pm ASSET + GROUP \pm DEBT \pm \sigma$$

where, π = rate of return on stockholders' equity;

σ = deviation in annual profits, defined as

$$\sum_{t=1}^{n} |\pi(t) - \pi(t-1)|/(n-1).$$

DEBT = leverage, defined as debt divided by the sum of debt and equity.

M = market share, estimated.

GROW = growth of sales.

GROUP = concentration, estimated, minus market share.

ADV = advertising as a percent of sales.

K/Y = capital (total assets) divided by sales.

ASSET = logarithm of average assets, used as a measure of firm size.

DV = demand variance.

Hurdle's model further demonstrates additional factors which may be added to our simple model to account for differences in rates of return. She adjusts for market share, advertising intensity, firm size, firm concentration, and leverage in her profit equation. Addition of the sales growth, capital intensity, and demand variance variables to the profit equation would be appropriate for future study. [Ref. 18:p. 481]

B. CAPITAL ASSET PRICING MODEL

If we accept the view that maximization of the market value of shareholders' equity is the primary objective of the firm and that financial markets are efficient, then the Capital Asset Pricing Model (CAPM) could prove to be useful in analyzing the relationship between risk and return.

The CAPM was developed by Sharpe, Lintner, and Mossin (SLM) in the 1960's in order to evaluate the relationship between expected return and nondiversifiable risk for security investments [Ref. 28:p. 54]. In so doing, they found it necessary to make the following simplifying assumptions regarding financial markets:

- Financial markets are highly efficient because all relevant information regarding securities is freely available to all investors;

- There are no transaction costs or taxes;

- There are negligible restrictions on investment, all investors can borrow or lend any amount without affecting the interest rate, and there is no risk of bankruptcy;

- No investor is large enough to affect the market price of securities;

- Investors are in general agreement about the likely performance and risk of individual securities, they are risk averse, and they reach their decisions using mean-variance theory; and

- Expectations are based on a given uniform investment period for all investors, approximately one year. [Ref. 28:p. 54]

This high degree of abstraction was necessary to remove decision variables which were too numerous and complex to contend with otherwise.

The CAPM is concerned with two types of investment: a risk-free security for which return over the holding period is known with certainty and a market portfolio of common stocks, represented by all outstanding shares valued at their combined market prices. The Treasury bill rate serves as surrogate for the risk-free rate, while indexes such as Standard & Poor's 500-stock Index, the New York Stock Exchange Composite Index, or the Wilshire 5000 Index serve as possible surrogates for the market portfolio.

Using historical data, SLM calculated returns for each individual stock and for the market portfolio. Regressing returns from each individual stock on market return, SLM obtained a linear relationship referred to as the characteristic line:

$$X_{it} = r + \beta_i X_{mt} + e_t$$

where X_{it} = rate of return on i th security in year t;

X_{mt} = rate of return on market portfolio in year t;

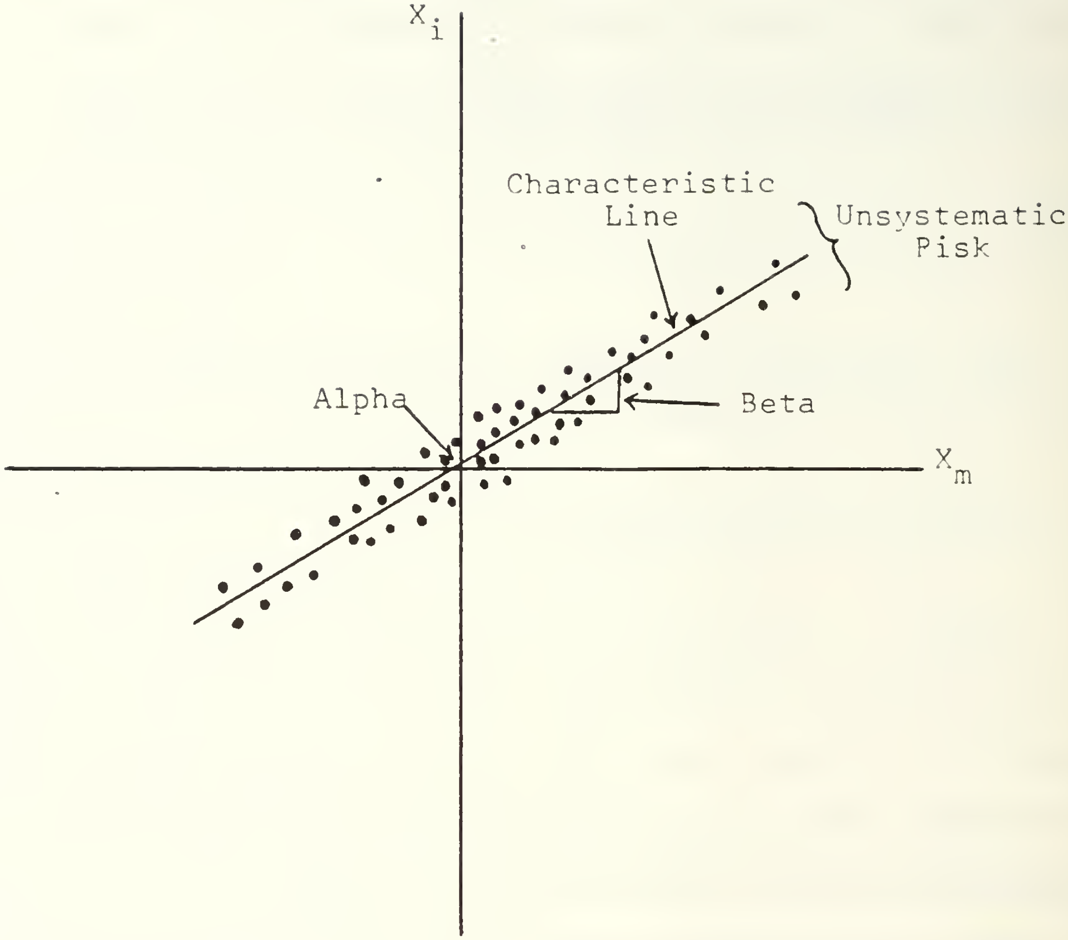
r = risk-free rate;

β_i = i th security's systematic risk; and

e_t = residual error about the regression line

Figure 11 indicates that these variables are positively correlated. Thus, expected returns on individual stocks increase as expected market return increases.

Beta (β), the slope of the characteristic line, measures the sensitivity of the return on an individual security to that of the market. Thus, beta represents the systematic risk of a stock resulting from security price movements. Systematic risk cannot be diversified away because it depends on changes in the economy, government intervention, changes



Source: [Ref. 28:p. 56]

Figure 11. Relationship Between Return on Stock and Market Return

in world oil supply, tax reform, and other factors which affect all stocks.

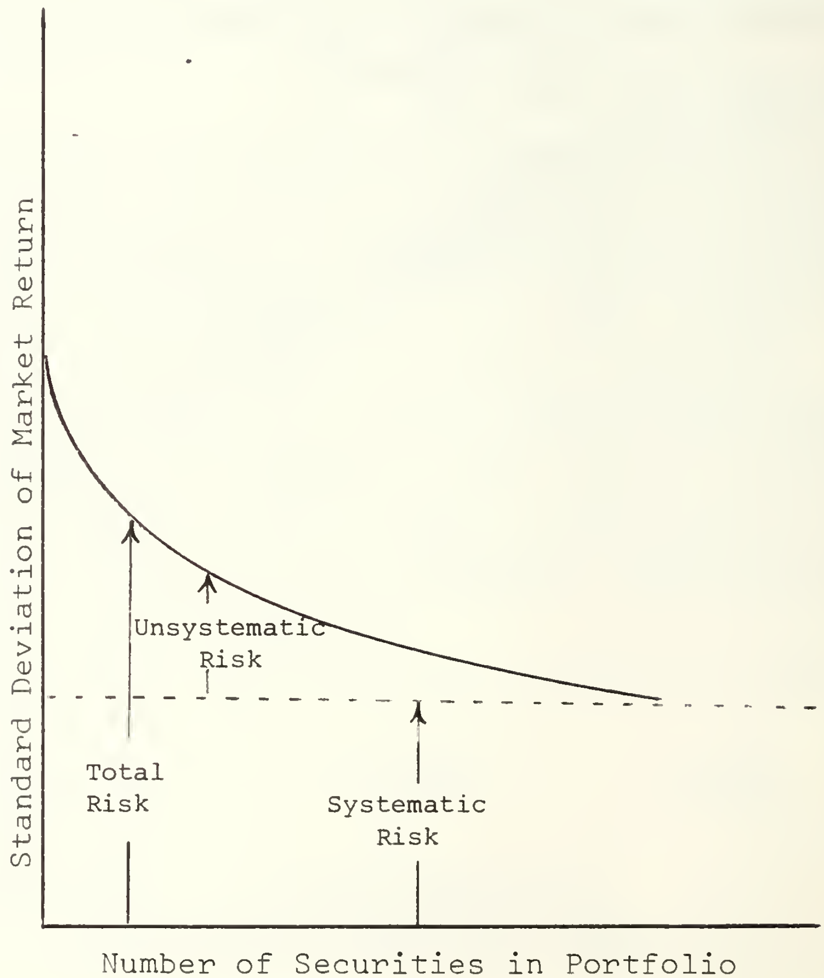
Unsystematic or avoidable risk is derived from that portion of variability of an individual stock's return which is not associated with market movements. Measured by the dispersion about the characteristic line, unsystematic risk was found by SLM to account for a substantial part of the total risk. Van Horne observes:

> For the typical stock, unsystematic risk or uncertainty accounts for approximately two-thirds of its total risk. However, by diversification this kind of risk can be reduced and even eliminated if diversification is efficient. Therefore, not all of the risk involved in holding a stock is relevant; part of it can be diversified away.
>
> Unsystematic risk is reduced at a decreasing rate toward zero as more randomly selected securities are added to the portfolio. Various studies suggest that fifteen to twenty stocks selected randomly are sufficient to eliminate most of the unsystematic risk of a portfolio. Thus, a substantial reduction in unsystematic risk can be achieved with a relatively moderate amount of diversification. [Ref. 28:p. 59]

Thus, total risk is represented as follows:

Total Risk	=	Systematic Risk	+	Unsystematic Risk
		[nondiversifiable or unavoidable]		[diversifiable or avoidable]

The CAPM assumes that all unsystematic risk is diversified away leaving only the unavoidable systematic risk as relevant. As Figure 12 demonstrates, relevant risk is not the variability of return on an individual stock (total risk) but the marginal effect that an individual stock has on the variability of return on an efficiently diversified portfolio (systematic risk).



Source: [Ref. 28:p. 60]

Figure 12. Total, Unsystematic, and Systematic Risk

With this assumption, the expected rate of return for an individual stock is:

$$\bar{X}_i = r + (\bar{X}_m - r)\beta_i$$

where X_i = expected rate of return on ith security;

r = risk-free rate;

$\bar{X}_m$ = expected rate of return on market portfolio;

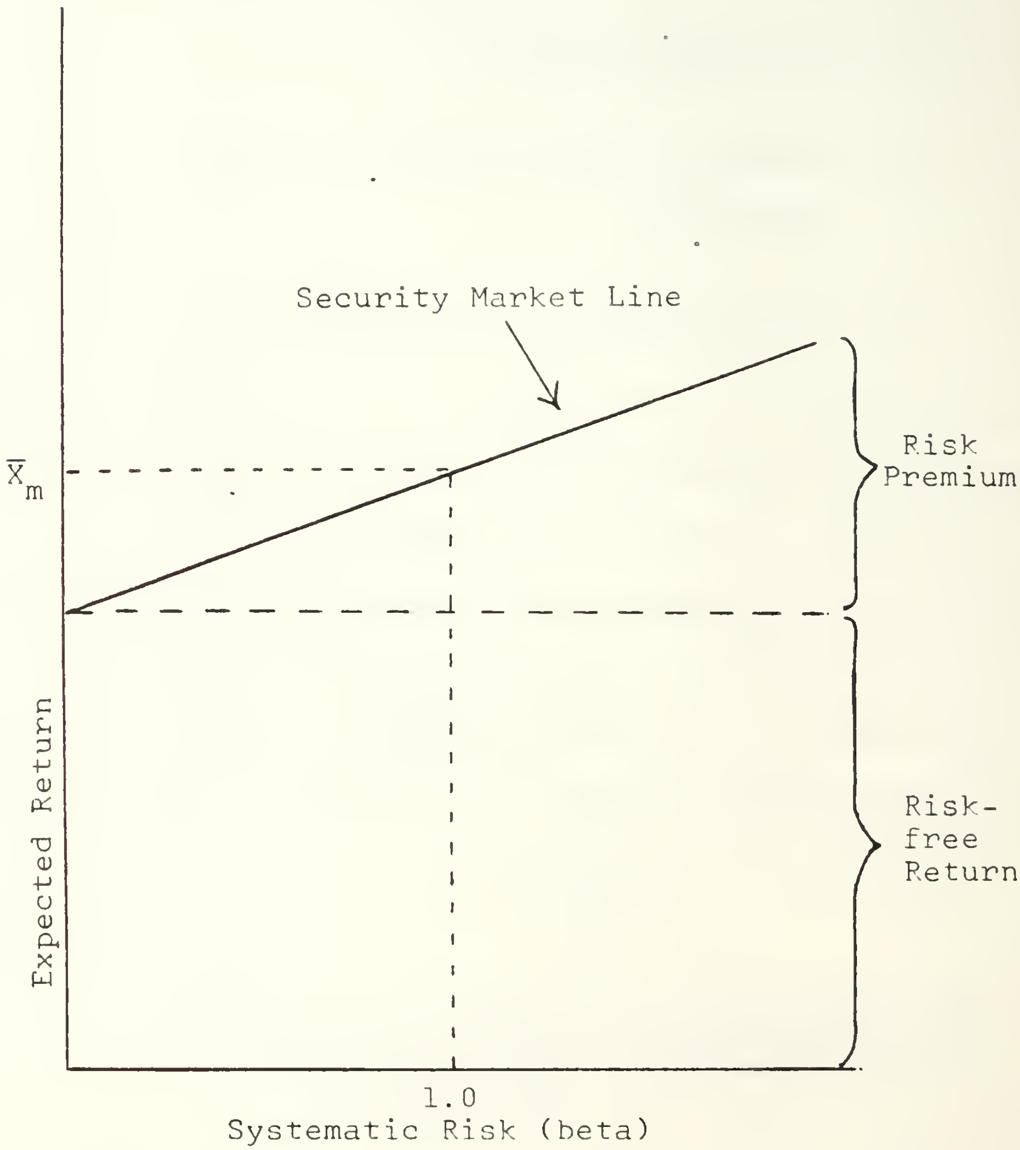
β_i = systematic risk of ith security

Thus, the expected rate of return for an individual stock is equal to the return required by the market for a risk-free investment, r, plus a risk premium, $(\bar{X}_m - r)\beta_i$.

Beta of an individual security reflects the responsiveness of that security's returns to those of the market. Beta can be measured by the covariance between return on security i and market return divided by the variance of the probability distribution for market return:

$$\hat{\beta}_i = \frac{\text{cov}\,(X_i, X_m)}{\sigma_m^2} = \frac{\sum_{i=1}^{n} (X_i - \bar{X}_i)(X_m - \bar{X}_m)}{\sum_{i=1}^{n} (X_m - \bar{X}_m)^2}$$

Also under the assumptions of the CAPM, the relationship between an individual security's expected rate of return and its systematic risk, in market equilibrium, is linear. Figure 13 illustrates this relationship which SLM refer to as the security market line.



Source: [Ref. 28:p. 62]

Figure 13. Security Market Line

Thus, the CAPM, framed within certain simplifying assumptions, implies a linear relationship between return on investment in a company's stock and the systematic risk associated with that investment. It further implies that the expected rate of return for an individual stock is the combination of the risk free rate plus a premium. This suggests that the CAPM would be useful in analyzing the risk-return relationship for investment in government contracting firms. Consequently, an empirical analysis of betas was performed.

1. Methodology

Betas for the 49 companies of Morse and Kramer's sample were obtained from The Value Line Investment Survey. [Ref. 49] Value Line betas are derived from regression analysis of weekly percent changes in stock prices and the NYSE Composite Index over a period of five years. These values are exhibited in Table 7 of Appendix B.

2. Analysis

Means and standard deviations of beta (β) were computed for the sample of 49 government contractors and the sub-samples of 36 commercially-oriented firms and 13 DOD-oriented firms as follows:

$$\text{mean} = \frac{\sum_{i=1}^{n} \beta_i}{n}$$

$$\text{std dev} = \left[\frac{\sum_{i=1}^{n} (\beta_i - \bar{\beta})^2}{n-1} \right]^{\frac{1}{2}}$$

Table 5 summarizes the results of the mean and standard deviation calculations:

TABLE 5

SAMPLE MEANS AND STANDARD DEVIATIONS OF BETA (β)

sample	mean	std dev
49 government contractors	1.10	0.13
36 commercially-oriented firms	1.09	0.13
13 DOD-oriented firms	1.14	0.12

This analysis indicates that the 13 DOD-oriented firms experienced a higher degree of systematic risk and a commensurately higher expected rate of return for investors than the 36 commercially-oriented firms. However, the small difference between mean betas suggests we should be cautious about such conclusions. A t-test for differences between the 13 and 36 indicates that there is no significant differences in the mean β's of the two groups.

Comparison of the relative rank of betas and variance coefficients from regressions of average rate of return on standard deviation from Section A, suggests that a possible relationship exists between earnings variation and systematic risk. However, the weak statistical evidence provided by the previous section precludes such a conclusion.

Whether earnings variability, investigated in Section A, is related to beta is an important consideration. Consequently, standard deviations of return on net worth, σ, from Section A, were regressed on measures of systematic risk, β, from this section. The resulting R^2 values, in the 0.20 range, for all three samples were too low to indicate any relationships. None of the regression coefficients were statistically significant.

3. Results

One of the main purposes for analyzing the risk-return relationship within the framework of the CAPM was to compare CAPM results with ROE variance results from Section A. One method could serve as a test for the other. However, since the model utilized in Section A was too simple to be useful, the desired results of this section have been diminished.

An unexpected result was the discovery of a missing link between a firm's accounting evaluation of the risk-return relationship and the securities market treatment of that relationship. Such a link is not necessary for development of a model to evaluate relationships among rate of return, risk, and leverage for defense contractors similar to that developed by Hurdle. However, finding the relationship between beta and earnings variability and obtaining comparative results would lend credibility to such a model.

The key to solving the problem of relating beta and earnings variability may lie in the fact that the variance of return on net worth deals with total risk; while beta is a measure of systematic risk. Myers suggests separating the variance of firms' earnings into systematic and unsystematic components:

> Both BKS (Beaver, Kettler, and Scholes) and Rosenberg-McKibben find earnings volatility to be strongly related to beta. This is mildly disturbing from a theoretical point of view, since earnings volatility represents the total, not the systematic risk of earnings; we would expect it to be less important than the "accounting beta" or some other measure of cyclicality. Nevertheless, earnings variability corresponds closely to the popular, intuitive idea of firm risk, and it is a sensible proxy for cyclicality. Thus, it certainly belongs on any tentative list of real factors associated with beta.
>
> However, it is unfortunate that no studies have separated the variance of firms' earnings into systematic and unsystematic components, and tested which component is more strongly related to beta. If the CAPM is right, the systematic component ought to be more important. [Ref. 50]

Myers found cyclicality, for which earnings volatility is an excellent proxy, to be a major determinant of beta. However, when he attempted to find a statistic to measure cyclicality and to specify the relationship between cyclicality and beta he found that the relationship is complicated, cannot be expressed as a simple linear function, and requires further study.

C. MEAN-VARIANCE ANALYSIS OF BACKLOG

If, as Hurdle suggests, the risk-return relationship is explained by several variables in a simultaneous-linear-equation multiple regression model, then it is plausible that backlog would be one of those variables which would collectively describe the market structure for defense contractors. Backlog consists of those orders which cannot currently be delivered but will be filled within a later time period, usually one year.

The monopsonistic condition characteristic of government contracting makes defense contractors susceptible to government demand. Backlog for most defense contractors would be the equivalent of Hurdle's market share variable. One difference, however, is that backlog measures future demand, whereas, market share is historical data.

Computation of backlog involves a substantial amount of estimating. A typical method for calculating a firm's backlog is as follows:

$$\text{Year-end Backlog} = \text{Previous Year Ending Backlog} + \text{Current Year Sales} - \text{Current Year Output}$$

Influences such as long-term contracts, partial or complete terminations, requirements and blanket orders where quantities are not specified, and seasonal demand make estimating backlog difficult.

Another consideration is that backlog, for some contractors, may account for a small portion of their total demand. It is anticipated that since several variables will comprise whatever model is developed, variables such as sales and sales growth, for example, may account for the remaining variance of profitability.

Thus, in this section, both total and government backlog are analyzed to determine the extent to which they explain rate of return variance.

1. Methodology

Total and government backlog data were collected from SEC 10K Reports over the period 1976-1984, adjusted such that it reflects only orders expected to be converted to sales within one year, and applied to Morse and Kramer's samples. The resulting sample data, exhibited in Table 6 in Appendix A, average annual backlog, y, were regressed on standard deviation, x, using an equation of the form:

$$y = a + bx$$

Companies for whom backlog has no meaning, for example automobile manufacturers and oil companies, were eliminated from the samples.

2. Analysis

a. Total Backlog

(1) Sample of 49 Contractors. Sample data for the 49 firms (37 due to elimination of 12 for whom backlog

has no meaning) were regressed resulting in the following values:

$$y = -148.7 + 3.18x, \qquad R^2 = 0.944$$
$$(361.8) \quad (0.42) \qquad \text{std error}$$

where, y = average annual total backlog

x = standard deviation

The computed t statistic for the b coefficient is:

$$t = 16.97$$

and critical t is:

$$t_{0.025} = 1.96$$

Since $t = 16.97 > t_{0.025} = 1.96$

we can reject the null hypothesis. Therefore, we conclude for the sample of 49 contractors that the coefficient b is statistically significant at the 0.05 level. We also conclude from the high value of R^2 that a positively correlated linear relationship exists between average total backlog and its variability for the sample of 49 contractors.

(2) Sample of 36 Commercially-Oriented Firms. Sample data for the 36 commercially-oriented firms (24 due to elimination of 12 for whom backlog has no meaning) were regressed resulting in the following values:

$$y = -191.0 + 3.78x, \qquad R^2 = 0.958$$
$$(1{,}043.28) \quad (1.56) \qquad \text{std error}$$

The computed t statistic for the b coefficient is:

$$t = 4.94$$

and critical t is:

$$t_{0.025} = 2.074$$

Since $t = 4.94 > t_{0.025} = 2.074$,

we can reject the null hypothesis. Therefore, we conclude for the sample of 36 commercially-oriented firms that the coefficient b is statistically significant at the 0.05 level. This sample is also positively correlated indicating a linear relationship between total backlog and its variance.

(3) Sample of 13 DOD-Oriented Firms. Sample data were present for all 13 DOD-oriented firms. Thus, they were regressed with the following results:

$$y = \underset{(1{,}916.63)}{-2{,}841.0} + \underset{(1.41)}{4.67x}, \qquad R^2 = 0.997$$

std error

The computed t statistic for the b coefficient is:

$$t = 7.34$$

and critical t is:

$$t_{0.025} = 2.201$$

Since $t = 7.34 > t_{0.025} = 2.201$

we can reject the null hypothesis. Therefore, we can conclude for the sample of 13 DOD-oriented firms that the coefficient b is statistically significant at the 0.05

level. This sample is also positively correlated and indicates a linear relationship between the mean and variance of total backlog.

b. Government Backlog

(1) Sample of 49 Contractors. Sample data for the 49 firms (37 due to elimination of 12 for whom backlog has no meaning) was regressed with the following results:

$$y_g = \underset{(151.7)}{57.72} + \underset{(0.25)}{1.97}x_g, \qquad R^2 = 0.683$$

std error

where y_g = average annual government backlog

x_g = standard deviation of government backlog

$t = 15.75$

$t_{0.025} = 1.96$

$t = 15.75 > t_{0.025} = 1.96$

$\therefore$ reject null hypothesis

We conclude that for the sample of 49 contractors the coefficient b is statistically significant at the 0.05 level. This sample is positively correlated and indicates a linear relationship.

(2) Sample of 36 Commercially-Oriented Firms. Regression results are as follows:

$$y_g = \underset{(100.84)}{26.66} + \underset{(0.45)}{2.21x_g}, \qquad R^2 = 0.912$$
std error

$$t = 10.41$$

$$t_{0.025} = 2.074$$

$$t = 10.41 > t_{0.025} = 2.074$$

$\therefore$ reject null hypothesis

We conclude that for the sample of 36 commercially-oriented firms the coefficient b is statistically significant and that a linear relationship is indicated.

(3) Sample of 13 DOD-Oriented Firms. Regression results are as follows:

$$y_g = \underset{(708.33)}{7.72} + \underset{(0.76)}{2.00x_g}, \qquad R^2 = 0.881$$
std error

$$t = 6.2$$

$$t_{0.025} = 2.2$$

$$t = 6.2 > t_{0.025} = 2.2$$

$\therefore$ reject null hypothesis

We conclude that for this sample the coefficient b is significant and that a linear relationship is indicated.

3. Results

Statistical findings are summarized as follows:

Sample of 49 firms:

Total backlog:

$$y = -148.7 + 3.18x, \qquad R^2 = 0.944$$
$$(361.8) \quad (0.42) \qquad \text{std error}$$

Government backlog:

$$y_g = 57.72 + 1.97x_g, \qquad R^2 = 0.683$$
$$(151.7) \quad (0.25) \qquad \text{std error}$$

Sample of 36 commercially-oriented firms:

Total backlog:

$$y = -191.0 + 3.78x, \qquad R^2 = 0.958$$
$$(1{,}043.28) \quad (1.56) \qquad \text{std error}$$

Government backlog:

$$y_g = 26.66 + 2.21x_g, \qquad R^2 = 0.912$$
$$(100.84) \quad (0.45) \qquad \text{std error}$$

Sample of 13 DOD-oriented firms:

Total backlog:

$$y = -2{,}841.0 + 4.67x, \qquad R^2 = 0.997$$
$$(1{,}916.63) \quad (1.41) \qquad \text{std error}$$

Government backlog:

$$y_g = 7.72 + 2.00x_g, \qquad R^2 = 0.881$$
$$(708.33) \quad (0.76) \qquad \text{std error}$$

These results coincide with a priori expectations. The high values of R^2 were somewhat surprising. These are probably due to the affects of autocorrelation which is expected to be present but which was not analyzed.

The coefficient signs for government backlog are positive again corresponding to a priori expectations. The negative intercept coefficients derived from the total backlog regressions were not expected. Note, however, that they are all small relative to their standard errors, so that all equations pass through the origin. We can conclude from this observation that the high values of the errors of estimate are another cause.

The results of the government backlog regressions are particularly encouraging because they explain a very high percentage of the differences in backlog among defense contractors. This would indicate that inclusion of a backlog variable in a model similar to that which Hurdle developed may explain some of the differences in corporate earnings among defense contractors.

In order to see if backlog could explain a portion of the differences in rates of return, average rate of return was regressed on the standard deviation of backlog. However, the resulting R^2 values, in the 0.20 range, for all three samples were too low to be useful. None of the regression coefficients were statistically significant.

This suggests the need for additional variables to explain the differences.

Thus, we conclude that, in a model such as that developed by Hurdle adapted to the government contracting environment, inclusion of a backlog variable as a proxy for demand or market share should explain a substantial portion of the differences in rate of return among contractors.

D. MEAN-VARIANCE ANALYSIS OF FIVE-YEAR DEFENSE PROGRAM ELEMENTS

The Five-Year Defense Program (FYDP) is the publication which summarizes decisions approved by the Secretary of Defense for program go-ahead. [Ref. 51] The FYDP provides manpower and costs associated with functions or projects accomplished in the past or to be accomplished in the future to support our national defense goals. These functions and projects, referred to as program elements, are aggregated within ten programs:

1. Strategic Forces
2. General Purpose Forces
3. Intelligence and Communications
4. Airlift and Sealift
5. Guard and Reserve Forces
6. Research and Development
7. Central Supply and Maintenance

8. Training, Medical and Other General Personnel Activities

9. Administrative and Associated Activities

10. Support of Other Nations

Cost associated with Research and Development (R&D) is of interest here. The value to corporate managers of future demand forecasting is well known. It assists them in decisions such as production scheduling, inventory management, pricing, and primarily, investment. Commercial firms rely on econometric forecasters for such analyses. Defense contractors rely on R&D planning summaries published by the component services of DOD and typically perform their own analyses.

Variations in DOD's funding of specific R&D programs may serve as a proxy for inherent program risk. Thus, average R&D program element budgeted costs are regressed on their standard deviations for selected programs over the period FY 1976-FY 1984.

1. Methodology

R&D funding data for 27 selected program elements were collected from The Five Year Defense Program Historical Summary and Program Detail FY 1962-FY 1984 [Ref. 51] for the period FY 1976-FY 1984. Criteria for program element selection included: program continuity over the period of consideration, program applicability to our sample of defense contractors, and magnitude of funding. Means and standard deviations of sample data are exhibited in Table 8 of Appendix C. Mean R&D funding is regressed on the standard deviation of the funding.

2. Analysis

Average R&D funding, y_p, and standard deviation, x, are approximated by an equation of the form:

$$y_p = a + bx$$

with the following results:

$$y_p = 11.47 + \underset{(0.15)}{1.26x}, \qquad R^2 = 0.961$$

std error

where y_p = average annual R&D program funding

x = standard deviation

The computed t statistic for the b coefficient is:

$$t = 17.48$$

and critical t is:

$$t_{0.025} = 2.06$$

Since $t = 17.48 > t_{0.025} = 2.06$

we can reject the null hypothesis. Therefore, we conclude that the coefficient b is statistically significant at the 0.05 level. The R^2 value indicates that a positively correlated linear relationship exists between R&D program funding and its variability.

3. Results

Results of the regression coincide with a priori expectations and support the theory that variance of program funding serves as proxy for intrinsic program risk.

Mean-variance analysis of aggregations of program elements applicable to a particular company should yield an overall measure of the risk inherent in developing such programs. Similar analyses could be performed on aggregates of program elements for comparisons of particular industries, for example between the aerospace, electronics, ordnance, or shipbuilding industries.

Thus, we conclude that inclusion of a variable to describe program variance in a model such as that developed by Hurdle may also explain a portion of the differences in rate of return among industries or among contractors.

VI. SUMMARY AND CONCLUSIONS

The overall purpose of this study was to analyze and measure, if possible, the relationship between defense contractor risk and rate of return. In so doing, we explored significant legislation, studies, and policies related to government contractor profitability and risk; observed, from the perspective of both the government and the contractor, the government contracting environment; analyzed the concept of risk; and empirically assessed four possible measures of risk: variability of return on net worth, stock prices, backlog, and R&D funding.

We noted that Fisher and Hall's study, Risk and the Aerospace Rate of Return, provided important empirical methods and was a similar attempt to analyze and measure risk for the aerospace industry.

DFAIR pointed us in the direction of concentrating on the interrelation among profit, financing and contract pricing policies rather than the usual comparison of profit.

Gloria Hurdle, in her paper, "Leverage, Risk, Market Structure and Profitability", provided us with an excellent model which could be adapted to parameters associated with government contracting; thereby providing us with a tool to evaluate the integrated relationships of profit, risk, leverage, and market structure among defense contractors.

Adaptation of such a model to the defense industry is a good area for further study.

Viewing the risk elements involved in government contracting from the perspective of both government and the contractor, has emphasized the need for equitable risk sharing.

On the basis of statistical findings, we concluded that variability of rate of return does not account for a sizeable enough portion of the differences in return to stand alone as a model. Additional variables must be added to the model. However, we also concluded, on the basis of statistical significance found for variance of return on net worth in the sample of 13 DOD-oriented firms, that standard deviation of return on net worth is a suitable proxy for total risk.

Evaluation of the Capital Asset Pricing Model (CAPM) yielded substantial empirical evidence from previous studies that beta represents systematic, or nondiversifiable, risk for a firm's stock as measured by the variance in stock prices. Because there is substantial empirical evidence regarding beta as an appropriate measure of systematic risk, it could serve as a test for the variance of return on net worth measure. Also, being able to relate beta to the standard deviation of return on net worth would be worthwhile, although presently difficult. This also provides an area for further study.

The mean-variance analysis of backlog resulted in the conclusion that backlog could serve as a suitable proxy for demand or market share. However, it was also determined that backlog would not stand alone as a suitable model either. Additional variables must be added to backlog in a multi-variable model to explain correctly the relationships among profit and risk.

Similarly, we found that variations in DOD's funding of specific R&D programs could serve as a suitable proxy for inherent program risk and demand variance.

What becomes abundantly clear from this study is that by focusing on the peculiar market structure of the defense industry, it should be possible to adapt a model such as Hurdle's "Leverage, Risk, Market Structure, and Profitability" model to describe these relationships for the defense industry. This finding provides a wealth of possibilities for further study.

APPENDIX A TABLES
TABLE 6 SEC DATA

(a) ALLIED CORPORATION
NYSE Symbol: ALD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	117.2	1,108.0	10.6	N/A	N/A
1977	135.0	1,197.0	11.3		
1978	120.0	1,272.0	9.4		
1979	11.0	1,229.0	0.9		
1980	280.0	1,664.0	16.8		
1981	376.0	1,900.0	19.8		
1982	281.0	2,013.0	14.0		
1983	450.0	2,747.0	16.4		
1984	488.0	3,043.0	16.0		
mean			12.8		
std dev			5.6		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(b) ATLANTIC RICHFIELD CO.
NYSE Symbol: ARC

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	575.2	4,091.1	14.1	N/A	N/A
1977	701.5	4,983.2	14.1		
1978	804.3	5,507.5	14.6		
1979	1,165.9	6,119.5	19.1		
1980	1,651.4	7,438.6	22.2		
1981	1,671.3	8,665.2	19.3		
1982	1,676.1	9,868.3	17.0		
1983	1,547.0	10,888.1	14.2		
1984	1,129.0	9,948.0	11.4		
mean			16.2		
std dev			3.4		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(c) AVCO CORPORATION
NYSE Symbol: AV

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	91.3	531.5	17.2	288.5	118.6
1977	116.6	633.9	18.4	394.1	158.6
1978	122.7	748.2	16.4	495.4	190.6
1979	132.3	889.7	14.9	592.4	212.9
1980	118.5	998.7	11.9	738.5	375.5
1981	70.0	1,025.3	6.8	1,096.7	643.7
1982	72.4	1,067.2	6.8	1,148.6	756.5
1983	102.6	1,137.9	9.0	1,450.0	981.4
1984	125.5	1,167.8	10.8	1,582.5	1,111.8
mean			12.5	865.2	505.5
std dev			4.4	470.7	378.8

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(d) BOEING COMPANY
NYSE Symbol: BA

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	102.9	1,084.8	9.5	3,366.0	1,128.8
1977	180.3	1,231.3	14.6	4,141.9	1,019.9
1978	322.9	1,473.6	21.9	6,915.5	983.3
1979	505.4	1,847.5	27.4	9,005.5	1,118.5
1980	600.5	2,314.8	25.9	8,213.1	1,545.7
1981	473.0	2,655.0	17.8	7,755.6	1,702.4
1982	292.0	2,813.0	10.4	9,132.0	2,310.2
1983	355.0	3,038.0	11.7	9,743.2	3,623.4
1984	787.0	3,695.0	21.3	9,895.1	3,384.7
mean			17.8	7,574.2	1,868.5
std dev			6.7	2,369.9	1,019.7

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(e) CHEVRON CORPORATION
NYSE Symbol: CHV

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	877.0	6,720.0	13.1	N/A	N/A
1977	992.0	7,327.0	13.5		
1978	1,089.0	7,987.0	13.6		
1979	1,785.0	9,284.0	19.2		
1980	2,401.0	11,077.0	21.7		
1981	2,380.0	12,703.0	18.7		
1982	1,377.0	13,246.0	10.4		
1983	1,590.0	14,106.0	11.3		
1984	1,534.0	14,763.0	10.4		
mean			14.7		
std dev			4.2		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(f) COASTAL CORPORATION
NYSE Symbol: CGP

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	58.4	512.0	11.4	N/A	N/A
1977	73.2	576.4	12.7		
1978	60.4	626.8	9.6		
1979	2.5	502.5	0.5		
1980	109.5	585.7	18.7		
1981	-20.4	477.0	-4.3		
1982	65.6	523.6	12.5		
1983	93.7	571.8	16.4		
1984	101.7	577.7	17.6		
mean			10.6		
std dev			7.8		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(g) CONTROL DATA CORPORATION
NYSE Symbol: CDA

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	44.2	905.8	4.9	414.0	136.6
1977	63.0	967.0	6.5	520.6	104.1
1978	89.5	1,057.9	8.5	717.0	64.5
1979	124.2	1,194.8	10.4	908.5	99.9
1980	150.8	1,454.7	10.4	993.0	99.3
1981	170.6	1,577.6	10.8	1,145.0	137.4
1982	156.5	1,725.0	9.1	962.0	163.5
1983	161.7	1,826.5	8.9	1,042.0	200.1
1984	31.6	1,775.6	1.8	1,132.0	194.6
mean			7.9	870.5	133.3
std dev			3.0	262.8	46.1

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(h) E-SYSTEMS, INC.
NYSE Symbol: ESY

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	14.5	56.5	25.7	302.6	220.9
1977	19.0	71.6	26.5	340.4	251.9
1978	12.7	92.3	13.8	400.8	280.6
1979	18.6	108.1	17.2	452.6	316.8
1980	12.8	140.2	9.1	410.5	287.3
1981	23.8	159.4	14.9	562.0	449.6
1982	35.8	191.0	18.7	651.1	520.9
1983	55.2	238.3	23.2	652.1	554.3
1984	61.1	285.9	21.4	769.4	684.8
mean			18.9	504.6	396.3
std dev			5.8	160.8	161.9

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(i) EMERSON ELECTRIC CO.
NYSE Symbol: EMR

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	129.1	756.2	17.1	383.9	28.7
1977	158.9	853.6	18.6	460.4	33.6
1978	187.4	969.6	19.3	546.6	39.8
1979	216.1	1,130.2	19.1	642.3	44.9
1980	246.1	1,277.1	19.3	723.9	53.9
1981	286.2	1,443.2	19.8	811.5	65.3
1982	300.1	1,558.7	19.3	805.1	84.5
1983	302.9	1,701.8	17.8	914.0	111.5
1984	349.2	1,869.2	18.7	1,079.0	124.1
mean			18.8	707.4	65.1
std dev			0.9	222.8	34.5

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(j) EXXON CORPORATION
NYSE Symbol: XON

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	2,641.0	15,861.8	16.7	N/A	N/A
1977	2,449.1	16,549.0	14.8		
1978	2,763.0	20,228.6	13.7		
1979	4,295.2	22,552.0	19.1		
1980	5,650.0	25,413.0	22.2		
1981	5,587.0	28,517.0	19.6		
1982	4,186.0	28,440.0	14.7		
1983	4,978.0	29,443.0	16.9		
1984	5,528.0	28,851.0	19.2		
mean			17.4		
std dev			2.8		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(k) FMC CORPORATION
NYSE Symbol: FMC

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	104.3	868.2	12.0	897.0	517.5
1977	126.7	951.8	13.3	1,057.7	580.5
1978	137.2	1,049.2	13.1	1,355.3	629.8
1979	133.9	1,153.3	11.6	1,324.6	595.0
1980	152.7	1,245.9	12.3	1,587.7	982.9
1981	190.8	1,302.3	14.7	2,177.6	1,616.3
1982	185.2	1,351.0	13.7	2,162.6	1,789.9
1983	188.4	1,460.4	12.9	1,888.7	1,674.3
1984	225.9	959.8	23.5	1,823.3	1,630.0
mean			14.1	1,586.1	1,112.9
std dev			3.7	461.8	553.5

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(1) FAIRCHILD INDUSTRIES, INC.
NYSE Symbol: FEN

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	4.9	65.4	7.5	262.0	238.4
1977	9.6	73.6	13.0	436.0	401.1
1978	24.5	97.8	25.1	565.0	446.3
1979	40.0	136.1	29.4	636.0	438.8
1980	54.5	188.9	28.9	916.0	586.2
1981	64.3	227.3	28.3	586.8	375.2
1982	35.3	237.4	14.9	407.0	248.7
1983	28.4	245.3	11.6	404.6	198.3
1984	1.4	222.9	0.6	472.7	243.1
mean			17.7	520.7	352.9
std dev			10.6	186.6	129.1

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(m) FORD MOTOR COMPANY
NYSE Symbol: F

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	983.1	7,157.9	13.7	N/A	N/A
1977	1,672.8	8,456.9	19.8		
1978	1,588.9	9,666.3	16.4		
1979	1,169.3	10,420.7	11.2		
1980	-1,543.3	8,567.5	-18.0		
1981	-1,060.1	7,362.2	-14.4		
1982	- 657.8	6,077.5	-10.8		
1983	1,866.9	7,545.3	24.7		
1984	2,907.0	9,837.7	29.6		
mean			8.0		
std dev			17.8		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(n) GENERAL DYNAMICS CORPORATION
NYSE Symbol: GD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	104.0	644.0	16.2	1,800.0	1,260.0
1977	109.0	733.0	14.9	2,200.0	1,562.0
1978	-46.0	674.0	-6.8	6,591.0	4,678.6
1979	179.0	826.0	21.7	7,468.0	5,124.3
1980	203.0	999.0	20.3	3,880.4	3,259.6
1981	147.0	1,072.0	13.7	3,391.4	2,984.4
1982	161.0	1,175.0	13.7	4,685.6	4,170.2
1983	286.6	1,261.0	22.7	5,442.3	4,680.4
1984	381.7	1,062.0	35.9	4,630.7	3,982.4
mean			16.9	4,454.4	3,522.4
std dev			11.3	1,880.7	1,378.2

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(o) GENERAL ELECTRIC COMPANY
NYSE Symbol: GE

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	930.6	5,253.0	17.7	6,426.0	963.9
1977	1,088.2	5,942.9	18.3	6,369.0	796.0
1978	1,229.7	6,586.7	18.7	7,831.0	978.9
1979	1,408.8	7,362.3	19.1	8,446.0	1,055.8
1980	1,514.0	8,200.0	18.5	11,782.0	1,472.8
1981	1,652.0	9,128.0	18.1	12,408.0	1,377.3
1982	1,817.0	10,198.0	17.8	12,070.9	1,667.2
1983	2,024.0	11,270.0	18.0	12,207.7	2,061.2
1984	2,280.0	12,573.0	18.1	12,731.5	2,059.2
mean			18.3	10,030.2	1,381.4
std dev			0.5	2,708.0	473.9

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(p) GENERAL MOTORS CORPORATION
NYSE Symbol: GM

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	2,902.8	14,385.2	20.2	N/A	N/A
1977	3,337.5	15,766.9	21.2		
1978	3,508.0	17,569.9	20.0		
1979	2,892.7	19,179.3	15.1		
1980	-762.5	17,814.6	-4.3		
1981	333.4	17,721.1	1.9		
1982	962.7	18,287.1	5.3		
1983	3,730.0	20,766.6	18.0		
1984	4,517.0	24,214.3	18.7		
mean			12.9		
std dev			9.4		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(q) GOODYEAR TIRE & RUBBER CO.
NYSE Symbol: GT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	120.6	1,860.9	6.5	144.6	144.6
1977	205.8	1,973.9	10.4	183.8	183.8
1978	226.1	2,108.2	10.7	216.4	216.4
1979	146.2	2,163.4	6.8	259.3	259.3
1980	206.7	2,302.5	9.0	315.1	315.1
1981	243.9	2,375.4	10.3	411.2	411.2
1982	247.6	2,457.2	10.1	542.0	542.0
1983	270.4	3,016.0	9.0	542.3	542.3
1984	411.0	3,171.3	13.0	599.5	599.5
mean			9.5	357.1	357.1
std dev			2.0	171.9	171.9

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(r) GOULD, INC.
NYSE Symbol: GLD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	23.6	190.0	4.3	622.4	56.0
1977	51.3	608.5	8.4	681.8	102.3
1978	68.1	685.5	9.9	828.9	88.7
1979	80.5	770.8	10.4	691.6	74.0
1980	59.2	803.0	7.4	773.2	85.8
1981	61.8	877.8	7.0	639.0	52.4
1982	79.9	887.5	9.0	691.0	116.8
1983	79.2	885.0	9.0	613.0	127.8
1984	89.3	854.7	10.5	693.8	145.7
mean			8.4	692.7	94.4
std dev			2.0	70.1	31.8

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(s) GRUMMAN CORPORATION
NYSE Symbol: GQ

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	23.6	190.0	12.4	649.1	606.2
1977	32.4	203.2	15.9	611.8	562.5
1978	20.0	216.4	9.2	786.4	702.0
1979	19.6	227.9	8.6	898.6	673.2
1980	30.7	266.3	11.5	991.0	787.3
1981	74.0	265.3	27.9	1,503.0	1,274.5
1982	90.3	315.4	28.6	1,919.0	1,643.1
1983	110.7	452.4	24.5	2,200.0	1,962.0
1984	108.4	543.6	19.9	2,764.0	2,250.9
mean			17.6	1,369.2	1,162.4
std dev			7.9	770.7	645.1

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(t) HARRIS CORPORATION
NYSE Symbol: HRS

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	26.9	200.2	13.4	280.0	75.6
1977	40.1	230.2	17.4	450.0	103.0
1978	52.2	278.2	18.8	575.0	139.8
1979	68.8	347.5	19.8	700.0	158.9
1980	79.7	453.0	17.6	950.0	222.3
1981	104.0	555.9	18.7	1,050.0	252.1
1982	101.5	596.7	17.0	1,000.0	322.0
1983	69.4	761.3	9.1	860.0	287.2
1984	80.4	818.1	9.8	1,031.0	360.9
mean			15.7	766.2	213.5
std dev			4.0	279.6	100.1

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(u) HERCULES, INC.
NYSE Symbol: HPC

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	110.5	764.1	14.5	100.0	80.0
1977	62.2	783.2	7.9	120.0	95.0
1978	108.4	848.4	12.8	155.0	124.0
1979	178.8	989.5	18.1	200.0	160.0
1980	114.5	1,053.3	10.9	295.0	235.0
1981	146.2	1,103.6	13.3	295.0	236.0
1982	109.8	1,141.3	9.6	345.0	275.0
1983	174.2	1,288.1	13.5	392.0	313.6
1984	197.2	1,366.9	14.4	585.0	448.5
mean			12.8	276.3	218.6
std dev			3.0	154.2	118.6

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(v) HONEYWELL, INC.
NYSE Symbol: HON

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	113.1	1,128.0	10.0	1,141.0	330.9
1977	143.7	1,189.9	12.1	1,389.3	452.8
1978	198.7	1,365.4	14.6	1,786.9	543.6
1979	256.4	1,616.9	15.9	2,045.1	617.5
1980	288.9	1,874.0	15.4	2,434.0	718.8
1981	259.3	2,098.0	12.4	2,786.0	824.9
1982	272.9	2,143.4	12.7	2,573.0	963.4
1983	231.2	2,313.7	10.0	2,794.0	1,068.1
1984	239.0	2,380.9	10.0	2,604.0	946.7
mean			12.6	2,172.6	718.5
std dev			2.3	614.4	251.8

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(w) ITT CORPORATION
NYSE Symbol: ITT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976			14.5	N/A	N/A
1977			13.7		
1978			13.0		
1979			12.3		
1980	894.3	6,273.5	14.3		
1981	666.7	6,116.2	10.9		
1982	632.6	6,082.9	10.4		
1983	638.2	6,108.1	10.5		
1984	302.5	6,032.7	5.0		
mean			11.6		
std dev			2.9		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(x) INTERNATIONAL BUSINESS MACHINES
NYSE Symbol: IBM

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	2,398.1	12,749.3	18.8	153.0	4.1
1977	2,719.4	12,618.5	21.6	285.0	7.7
1978	3,110.6	13,493.6	23.1	375.0	9.8
1979	3,011.3	14,981.2	20.1	450.0	12.0
1980	3,562.0	16,453.0	21.7	545.0	13.5
1981	3,308.0	18,161.0	18.2	595.0	14.7
1982	4,409.0	19,960.0	22.1	705.8	17.9
1983	5,485.0	23,219.0	23.6	825.0	25.1
1984	6,582.0	26,489.0	24.9	944.0	33.3
mean			21.5	541.9	15.3
std dev			2.3	256.2	9.0

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(y) LITTON INDUSTRIES, INC.
NYSE Symbol: LIT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	28.3	806.2	3.5	1,116.3	666.0
1977	55.9	856.1	6.5	1,153.9	628.5
1978	-90.8	759.3	-12.0	1,680.7	504.2
1979	188.9	930.8	20.3	3,006.9	781.6
1980	255.9	1,166.8	21.9	3,219.4	1,385.1
1981	293.9	1,422.6	20.7	1,865.5	968.1
1982	324.7	1,676.9	19.4	1,767.0	1,056.9
1983	250.9	1,829.6	13.7	1,791.0	1,160.6
1984	277.4	2,010.9	13.8	1,797.0	1,308.8
mean			12.0	1,933.1	939.9
std dev			11.1	726.0	313.1

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(z) LOCKHEED CORPORATION
NYSE Symbol: LK

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	43.0	167.0	25.8	1,500.0	900.0
1977	58.3	219.0	26.6	1,832.5	1,130.2
1978	55.0	280.0	19.6	2,356.9	1,546.1
1979	36.5	283.0	12.9	2,678.9	1,905.1
1980	27.6	306.2	9.0	2,853.9	2,123.9
1981	155.0	418.4	37.1	3,430.0	2,782.9
1982	-2.0	622.4	-0.3	3,780.0	3,154.5
1983	262.8	826.2	31.8	5,390.0	4,583.5
1984	344.1	1,151.9	29.9	6,605.2	5,616.8
mean			21.4	3,380.8	2,638.1
std dev			12.1	1,671.4	1,590.4

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(aa) MARTIN MARIETTA CORPORATION
NYSE Symbol: ML

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	78.5	657.9	11.9	160.0	135.0
1977	102.1	725.6	14.1	232.5	197.0
1978	136.0	863.9	15.7	247.5	210.0
1979	178.0	969.5	18.4	340.0	288.5
1980	230.2	1,103.1	20.9	478.3	406.5
1981	200.1	1,200.0	16.7	966.3	821.4
1982	105.7	436.6	24.2	830.6	706.0
1983	161.6	845.3	19.1	1,483.0	1,260.5
1984	176.0	626.0	28.1	1,929.5	1,640.0
mean			18.8	740.9	629.4
std dev			5.1	621.6	528.6

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(bb) McDONNELL DOUGLAS CORPORATION
NYSE Symbol: MD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	108.3	945.3	11.5	2,948.0	2,288.0
1977	123.0	1,055.8	11.7	3,893.5	2,545.5
1978	161.1	1,199.8	13.4	5,402.0	2,686.7
1979	199.1	1,378.2	14.5	6,672.0	3,337.9
1980	144.6	1,512.5	9.6	6,502.1	4,265.9
1981	176.6	1,653.5	10.7	7,219.8	6,020.1
1982	214.7	1,819.6	11.8	6,528.2	5,072.4
1983	274.9	2,067.9	13.3	8,234.0	6,175.5
1984	325.3	2,343.8	13.9	9,282.0	6,571.6
mean			12.2	6,298.0	4,329.3
std dev			1.6	1,985.7	1,691.2

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(cc) MOBIL CORPORATION
NYSE Symbol: MOB

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	973.0	7,739.0	12.6	N/A	N/A
1977	1,026.0	8,358.0	12.3		
1978	1,131.0	9,037.0	12.5		
1979	2,007.0	10,513.0	19.1		
1980	3,272.0	13,069.0	25.0		
1981	2,434.0	14,657.0	16.6		
1982	1,380.0	14,742.0	9.4		
1983	1,503.0	13,952.0	10.8		
1984	1,270.0	13,624.0	9.3		
mean			14.2		
std dev			5.2		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(dd) MORTON THIOKOL, INC.
NYSE Symbol: MTI

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976			13.0	N/A	N/A
1977			13.4		
1978			12.8		
1979	46.1	318.8	14.5		
1980	47.7	348.1	13.7		
1981	53.0	382.2	13.9		
1982	136.5	383.9	35.6		
1983	78.5	550.5	14.3		
1984	109.8	636.3	17.3		
mean			16.5		
std dev			7.3		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(ee) MOTOROLA, INC.
NYSE Symbol: MOT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	97.0	737.2	13.2	368.1	47.9
1977	116.1	839.4	13.8	502.0	52.7
1978	137.4	958.7	14.3	660.9	66.8
1979	171.0	1,099.0	15.6	945.2	101.2
1980	192.0	1,250.0	15.4	1,049.8	109.2
1981	182.0	1,409.0	12.9	1,047.2	119.4
1982	178.0	1,700.0	10.5	1,151.2	157.7
1983	244.0	1,948.0	12.5	2,014.7	251.7
1984	387.0	2,278.0	17.0	2,110.4	265.6
mean			13.9	1,094.4	130.2
std dev			1.9	609.8	80.7

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(ff) NORTHROP CORPORATION
NYSE Symbol: NOC

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	35.9	225.8	15.9	1,175.5	987.4
1977	66.2	285.2	23.2	929.5	743.6
1978	88.4	356.0	24.8	598.0	424.6
1979	90.3	420.4	21.5	1,092.0	677.0
1980	86.1	482.4	17.9	1,560.3	1,123.4
1981	5.4	493.9	1.1	1,729.5	1,349.0
1982	47.8	507.0	9.4	2,220.0	1,842.6
1983	100.7	576.9	17.5	2,268.7	1,701.6
1984	166.9	724.8	23.0	3,067.6	2,300.7
mean			17.1	1,626.8	1,238.9
std dev			7.7	781.8	614.3

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(gg) PENN CENTRAL CORPORATION
NYSE Symbol: PC

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	-108.3	158.7	-68.2	0.0	0.0
1977	- 53.2	140.3	-37.9	0.0	0.0
1978	4.5	362.7	1.2	0.0	0.0
1979	57.0	489.5	11.6	288.5	0.0
1980	93.6	1,081.2	8.7	311.0	0.0
1981	168.7	1,309.3	12.9	745.6	251.7
1982	131.5	1,467.7	9.0	555.9	203.7
1983	19.7	1,441.4	1.4	740.5	369.4
1984	170.0	1,619.2	10.5	637.9	358.9
mean			7.9	364.4	131.5
std dev			4.7	317.3	163.7

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(hh) RCA CORPORATION
NYSE Symbol: RCA

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	177.4	1,277.7	13.9	292.0	292.0
1977	247.0	1,430.3	17.3	320.3	320.3
1978	278.4	1,599.3	17.4	401.8	401.8
1979	283.8	1,759.8	16.1	452.2	452.2
1980	315.3	1,862.2	16.9	529.9	529.9
1981	54.0	1,687.9	3.2	581.8	581.8
1982	222.6	1,887.7	11.8	743.4	743.4
1983	240.8	1,981.4	12.2	854.0	854.0
1984	271.3	2,090.0	13.0	1,039.8	1,039.8
mean			13.5	579.5	579.5
std dev			4.5	253.5	253.5

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(ii) RAYTHEON COMPANY
NYSE Symbol: RTN

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	105.4	536.2	19.7	1,561.0	485.4
1977	140.8	623.4	22.6	1,848.0	657.1
1978	181.0	739.1	24.5	1,858.0	740.2
1979	234.7	1,086.5	21.6	1,788.0	647.8
1980	275.4	1,303.5	21.1	2,648.0	913.3
1981	322.9	1,536.0	21.0	3,353.0	1,334.1
1982	303.4	1,711.8	17.7	3,309.0	1,653.7
1983	308.6	1,887.4	16.4	3,505.0	2,173.1
1984	340.1	1,979.2	17.2	3,483.0	2,257.2
mean			20.2	2,594.8	1,206.9
std dev			2.7	831.1	679.3

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(jj) REYNOLDS (R.J.) INDUSTRIES, INC.
NYSE Symbol: RJR

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	353.2	2,066.3	17.1	N/A	N/A
1977	423.5	2,391.7	17.7		
1978	441.9	2,629.5	16.8		
1979	550.9	2,997.8	18.4		
1980	670.4	3,445.4	19.4		
1981	767.8	3,929.5	19.5		
1982	890.0	4,766.0	18.7		
1983	835.0	5,233.0	16.0		
1984	843.0	4,478.0	18.8		
mean			18.1		
std dev			1.2		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(kk) ROCKWELL INTERNATIONAL CORPORATION
NYSE Symbol: ROK

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	122.2	1,181.5	10.3	2,010.0	895.0
1977	144.1	1,252.1	11.5	2,620.0	1,100.0
1978	176.6	1,354.6	13.0	2,930.0	1,030.0
1979	261.1	1,539.2	17.0	3,650.0	955.0
1980	280.2	1,740.2	16.1	3,770.0	1,090.0
1981	291.8	1,910.6	15.3	3,640.0	1,290.0
1982	331.6	2,097.3	15.8	3,840.0	2,450.0
1983	389.1	2,367.3	16.4	4,860.0	3,360.0
1984	496.5	2,521.6	19.7	7,020.0	5,280.0
mean			15.0	3,815.6	1,938.9
std dev			2.9	1,453.2	1,507.2

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(11) ROYAL DUTCH PETROLEUM COMPANY
NYSE Symbol: RD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	2,511.0	20,712.0	12.1	N/A	N/A
1977	2,734.0	23,136.0	11.8		
1978	2,136.0	25,245.0	8.5		
1979	4,271.4	22,436.4	19.0		
1980	3,115.0	24,873.8	12.5		
1981	2,515.8	28,393.4	8.9		
1982	2,790.2	36,590.4	7.6		
1983	3,855.6	40,965.4	9.4		
1984	5,107.2	46,000.0	11.1		
mean			11.2		
std dev			3.4		

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(mm) SANDERS ASSOCIATES, INC.
NYSE Symbol: SAA

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	5.7	29.3	19.5	88.3	80.5
1977	-4.9	24.7	-19.8	60.2	53.3
1978	19.3	56.5	34.2	89.6	76.9
1979	14.4	65.3	22.1	113.7	81.1
1980	18.5	130.5	14.2	177.7	120.2
1981	26.4	174.8	15.1	180.2	132.9
1982	21.9	150.9	14.5	300.0	226.9
1983	37.0	281.0	13.2	376.8	286.9
1984	49.0	317.3	15.4	460.5	352.5
mean			14.3	205.2	156.8
std dev			14.4	142.1	106.5

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(nn) THE SIGNAL COMPANIES, INC.
NYSE Symbol: SGN

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	64.8	814.2	8.0	564.0	169.2
1977	101.5	874.2	11.6	665.0	219.5
1978	160.7	1,000.8	16.1	824.0	238.9
1979	203.7	1,183.7	17.2	1,193.3	286.4
1980	167.7	1,312.6	12.8	1,269.6	317.4
1981	214.0	1,658.2	12.9	1,345.9	376.9
1982	113.2	1,694.5	6.7	1,238.0	383.8
1983	103.0	2,633.0	3.9	1,682.0	555.0
1984	285.0	2,805.0	10.2	1,841.0	681.2
mean			11.0	1,180.3	358.7
std dev			4.3	432.9	165.9

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(oo) SINGER COMPANY
NYSE Symbol: SMF

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	74.2	373.3	19.9	251.3	251.3
1977	94.2	443.6	21.2	329.0	329.0
1978	62.8	488.5	12.9	367.5	367.5
1979	-92.3	382.5	-24.1	406.0	406.0
1980	38.1	413.6	9.2	560.6	560.6
1981	38.4	445.3	8.6	600.0	600.0
1982	- 2.9	435.5	- 0.7	600.0	600.0
1983	31.6	435.4	7.3	630.0	630.0
1984	65.1	483.7	13.5	720.0	720.0
mean			7.5	496.0	496.0
std dev			13.6	160.6	160.6

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(pp) SPERRY CORPORATION
NYSE Symbol: SY

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	145.3	1,169.3	12.4	1,460.4	424.4
1977	156.8	1,296.1	12.1	1,668.0	440.0
1978	176.6	1,434.3	12.3	2,096.7	524.6
1979	224.1	1,630.6	13.7	2,384.8	531.7
1980	274.4	2,384.4	11.5	2,730.2	620.5
1981	311.2	2,389.8	13.1	2,793.5	723.2
1982	221.8	2,391.5	9.3	2,878.5	812.2
1983	118.1	2,398.9	4.9	2,661.2	951.2
1984	216.2	2,802.9	7.7	2,803.8	1,118.4
mean			10.8	2,386.3	682.9
std dev			2.9	528.4	239.2

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(qq) TRW INC.
NYSE Symbol: TRW

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	267.0	830.0	32.2	762.3	424.4
1977	154.0	925.0	16.7	944.0	440.0
1978	174.0	1,033.0	16.8	1,256.0	524.6
1979	189.0	1,194.0	15.8	1,441.4	531.7
1980	204.0	1,303.0	15.7	1,562.0	620.5
1981	228.8	1,417.6	16.1	1,562.0	723.2
1982	196.3	1,519.4	12.9	2,010.0	812.2
1983	205.2	1,613.9	12.7	2,108.0	951.2
1984	266.8	1,756.6	15.2	2,432.0	1,118.4
mean			17.1	1,564.2	682.9
std dev			5.8	546.0	239.2

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6. SEC DATA

(rr) TELEDYNE, INC.
NYSE Symbol: TDY

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	134.9	493.6	27.3	963.2	263.3
1977	194.1	683.2	28.4	934.6	172.1
1978	248.5	865.7	28.7	1,143.7	194.4
1979	372.0	1,275.4	29.2	1,466.9	228.9
1980	343.8	1,401.3	24.5	1,533.4	260.7
1981	412.3	1,706.5	24.2	1,584.0	285.1
1982	260.8	2,086.4	12.5	1,479.0	340.2
1983	304.6	2,641.2	11.5	1,700.0	391.0
1984	574.3	1,159.3	49.5	1,701.0	403.1
mean			26.2	1,389.5	282.1
std dev			11.0	299.0	81.6

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(ss) TENNECO, INC.
NYSE Symbol: TGT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	275.3	1,605.6	17.2	715.0	715.0
1977	310.4	1,654.4	18.8	663.0	663.0
1978	274.0	1,297.0	21.1	650.0	650.0
1979	296.0	1,238.0	23.9	611.0	611.0
1980	458.0	1,562.0	29.3	827.0	827.0
1981	642.0	1,743.0	36.8	990.0	990.0
1982	542.0	1,691.0	32.1	1,200.0	1,200.0
1983	478.0	1,636.0	29.2	1,300.0	1,300.0
1984	309.0	6,440.0	4.8	1,700.0	1,700.0
mean			23.7	961.8	961.8
std dev			9.6	371.7	371.7

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(tt) TEXTRON, INC.
NYSE Symbol: TXT

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	121.1	839.3	14.4	378.0	204.0
1977	136.9	921.7	14.9	516.0	168.0
1978	168.1	1,015.9	16.6	884.0	442.0
1979	168.5	1,085.0	15.5	1,010.0	358.0
1980	169.4	1,153.8	14.7	1,149.0	307.0
1981	145.8	1,227.0	11.9	1,206.0	464.0
1982	84.4	1,227.3	6.9	1,201.0	449.0
1983	88.7	1,189.7	7.5	1,266.0	469.0
1984	113.5	1,187.7	9.6	1,600.0	601.0
mean			12.4	1,023.3	384.7
std dev			3.6	381.7	138.7

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(uu) TODD SHIPYARDS CORPORATION
NYSE Symbol: TOD

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	-1.3	10.5	-12.4	80.0	62.0
1977	0.3	10.8	2.6	137.5	120.0
1978	-0.3	10.5	- 2.9	250.0	212.5
1979	6.1	21.7	28.1	280.0	238.0
1980	19.4	58.7	33.1	300.0	255.0
1981	23.0	80.2	28.7	325.0	276.3
1982	31.7	116.9	27.1	500.0	425.0
1983	30.2	124.4	24.3	360.0	306.0
1984	21.9	130.7	16.8	300.0	255.0
mean			16.2	281.4	238.9
std dev			16.3	121.9	104.4

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(vv) UNITED TECHNOLOGIES CORPORATION
NYSE Symbol: UTX

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	157.4	1,244.6	12.7	3,185.0	923.7
1977	196.0	1,456.8	13.5	4,290.0	1,287.0
1978	234.1	1,772.8	13.2	5,638.8	1,522.4
1979	325.6	2,510.3	13.0	6,825.0	1,569.8
1980	393.4	2,734.9	14.4	7,410.0	1,630.2
1981	457.7	3,212.5	14.3	7,572.5	2,120.2
1982	533.7	3,481.8	15.3	7,605.0	2,509.7
1983	509.2	3,783.7	13.5	7,865.0	2,595.5
1984	645.0	4,169.4	15.5	8,000.0	2,700.0
mean			13.9	6,487.9	1,873.2
std dev			1.0	1,733.2	631.5

Source: SEC 10K reports

APPENDIX A TABLES
TABLE 6 SEC DATA

(ww) WESTINGHOUSE ELECTRIC CORPORATION
NYSE Symbol: WX

	NET INCOME ($millions)	NET WORTH ($millions)	RETURN ON EQUITY %	TOTAL BACKLOG ($millions)	GOVERNMENT BACKLOG ($millions)
1976	223.2	2,138.4	10.4	4,800.0	527.2
1977	250.8	2,293.9	10.9	3,000.0	329.9
1978	243.4	2,439.1	10.0	3,500.0	629.6
1979	-73.9	2,250.0	-3.3	3,800.0	446.3
1980	402.9	2,529.9	15.9	3,900.0	502.7
1981	438.0	2,820.7	15.5	4,200.0	586.9
1982	449.3	3,175.0	14.2	4,500.0	756.2
1983	449.0	3,410.3	13.2	4,300.0	845.6
1984	535.9	3,740.8	14.3	4,500.0	833.1
mean			11.2	4,055.6	606.4
std dev			5.9	563.7	177.2

Source: SEC 10K reports

APPENDIX B TABLE
TABLE 7

BETA DATA

Company	NYSE Symbol	Beta	Company	NYSE Symbol	Beta
Allied Corp.	ALD	1.05	Atlantic Richfield Co.	ARC	1.10
AVCO Corp.	AV	1.05	Boeing Co.	BA	1.20
Chevron Corp.	CHV	1.10	Coastal Corp.	CGP	1.20
Control Data Corp.	CDA	1.45	E-Systems, Inc.	ESY	1.25
Emerson Electric Co.	EMR	0.90	EXXON Corp.	XON	0.80
FMC Corp.	FMC	0.90	Fairchild Industries, Inc.	FEN	1.05
Ford Motor Co.	F	1.25	General Dynamics Corp.	GD	1.30
General Electric Co.	GE	1.00	General Motors Corp.	GM	1.15
Goodyear Tire & Rubber	GT	1.10	Gould, Inc.	GLD	1.15
Grumman Corp.	GQ	0.95	Harris Corp.	HRS	1.10
Hercules, Inc.	HPC	1.10	Honeywell, Inc.	HON	1.20
ITT Corp.	ITT	1.05	International Business Machines	IBM	1.00
Litton Industries, Inc.	LIT	1.30	Lockheed Corp.	LK	1.15

Source: Value Line

TABLE 7 (continued)

Company	NYSE Symbol	Beta	Company	NYSE Symbol	Beta
Martin Marietta Corp.	ML	1.30	McDonnell Douglas Corp.	MD	1.05
Mobil Corp.	MOB	1.05	Morton Thiokol, Inc.	MTI	0.95
Motorola, Inc.	MOT	1.25	Northrop Corp.	NOC	1.10
Penn Central Corp.	PC	1.00	RCA Corp.	RCA	1.05
Raytheon Co.	RTN	1.15	Reynolds (R.J.) Industries	RJR	0.90
Rockwell International	ROK	1.15	Royal Dutch Petroleum Co.	RD	1.05
Sanders Associates	SAA	1.10	The Signal Companies, Inc.	SGN	1.05
Singer Co.	SMF	1.15	Sperry Corp.	SY	1.25
TRW, Inc.	TRW	1.00	Teledyne, Inc.	TDY	1.15
Tenneco, Inc.	TGT	1.05	Textron, Inc.	TXT	1.05
Todd Shipyards Corp.	TOD	0.90	United Technologies Corp.	UTX	1.15
Westinghouse Electric	WX	1.30			

Source: Value Line

APPENDIX C TABLE
TABLE 8

FIVE-YEAR DEFENSE PROGRAM ELEMENTS

Five Year Defense Program (FYDP) Program Element		FY 76 - FY 84 R&D Funding $million	
Number	Title	Mean	Std Dev
62102F	Materials	36.4	7.6
62203F	Aerospace Propulsion	46.6	8.1
62302F	Rocket Propulsion	29.6	5.2
62601A	Tank and Auto Technology	12.6	5.5
62708E	Integrated C^3 Technology	33.7	8.5
62709A	Night Vision Investigations	9.8	3.7
62725A	Computer Info Science	2.2	0.5
63203F	Adv Avionics for Aircraft	12.9	4.3
63216F	Adv Turbine Eng Gas Generator	22.2	8.4
63230F	Adv Tactical Fighter	6.6	12.2
63314F	Strategic Laser Sys Technology	20.0	24.1
63401F	Adv Spacecraft Technology	6.9	3.2
63431F	Space Communication	33.0	13.4
63509N	New Ship Design	7.5	6.2

Source: FYDP: The Five Year Defense Program Historical Summary and Program Detail FY 1962 - FY 1984

TABLE 8 (continued)

Five Year Defense Program (FYDP) Program Element		FY 76 - FY 84 R&D Funding $million	
Number	Title	Mean	Std Dev
63605F	Adv Radiation Technology	72.0	15.3
64207A	Adv Attack Helo	116.4	63.2
64212N	LAMPS MKIII	74.5	61.5
64260N	C/MH 53E	12.9	7.8
64263N	F/A 18	261.8	201.6
64303N	AEGIS	26.5	17.5
64307A	PATRIOT Air Def Missle Sys	126.3	68.5
64358N	PHALANX	6.0	6.9
64361F	Air Launched Cruise Missle	137.2	105.5
64362F	Ground Launched Cruise Missle	39.6	35.3
64406F	Space Def System	107.9	83.2
64710F	Reconnaissance Equip	10.1	3.4
64754F	Joint Tactical Info Distr Sys	42.9	16.7

Source: FYDP: The Five Year Defense Program Historical Summary and Program Detail FY 1962 - FY 1984

LIST OF REFERENCES

1. Office of the Secretary of Defense (OSD), Defense Financial and Investment Review (DFAIR), June 1985.

2. Weidenbaum, Murray, L., The Economics of Peacetime Defense, Praeger Publishers, New York, 1974.

3. White, Eston, T., and Hendrix, Val, E., Defense Acquisition and Logistics Management, National Defense University, Washington, D.C., 1984, p. 68.

4. Comptroller General of the United States, Causes of Excessive Profits on Defense and Space Contracts, PSAD-76-56, August 4, 1975, pp. i-ii.

5. Weinberger, Caspar, W., Secretary of Defense, "Running a 'business' the size of the Department of Defense", Speech delivered by Secretary Weinberger to the Federal Procurement and Trade Conference, Indianapolis, Indiana, July 1984, Program Manager, The Journal of the Defense Systems Management College, Defense Systems Management College, Fort Belvoir, Virginia, January 1984, pp. 10-12.

6. Logistics Management Institute (LMI), Profit '76 (LMI Task 76-3), December 1976, pp. 1-8.

7. Logistics Management Institute, Defense Industry Profit Review, (LMI Task 66-25), November 1967.

8. Weidenbaum, Murray, L., "Arms and the American Economy: A Domestic Convergence Hypothesis", American Economic Review, Papers and Proceedings, Washington, D.C., December 28-30, 1967.

9. Fisher, Irving, N. and Hall, George, R., Risk and the Aerospace Rate of Return, The Rand Corporation, December 1967.

10. Logistics Management Institute (LMI), Defense Industry Profit Review, (LMI Task 69-1), March 1969.

11. Logistics Management Institute (LMI), Defense Industry Profit Review, (LMI Task 69-27), March 1970.

12. Comptroller General of the United States, Defense Industry Profit Study, Report to the Congress, March 17, 1971, B-159896.

13. Aerospace Industries Association of America (AIA), Inc., Risk Elements in Government Contracting, AIA, Washington, D.C., October 1970.

14. _______________, Aerospace Profits vs. Risks, June 1971.

15. Bohi, Douglas, R., "Profit Performance in the Defense Industry", Journal of Political Economy, June 1973.

16. Carroll, Sidney, L., "Profits in the Airframe Industry", Quarterly Journal of Economics, November 1972.

17. Poirier, Dale, J. and Garber, Steven, G., "The Determinants of Aerospace Profit Rates 1951-1971", Southern Economic Journal, October 1974.

18. Hurdle, Gloria, J., "Leverage, Risk, Market Structure and Profitability", Review of Economics and Statistics, 56, November 1974.

19. Shepherd, W.G., "The Elements of Market Structure", The Review of Economics and Statistics, LIV, February 1972, p. 28.

20. Internal Revenue Service, "List of Minor Manufacturing Industries". Available annually upon request.

21. Scherer, F.M., Industrial Market Structure and Economic Performance, Rand McNally, Chicago, 1970, pp. 192-198.

22. Office of Assistant Secretary of Defense (Installations and Logistics), "Profit '76 Summary Report", December 1976.

23. Comptroller General of the United States, "GAO Review of Profit '76", Letter to the Secretary of Defense re GAO Report B-159896, PSAD-77-75, February 17, 1977.

24. _______________, "Recent Changes in the Defense Department's Profit Policy - Intended Results Not Achieved", GAO Report to Congress, PSAD-79-38, March 8, 1979.

25. Defense Systems Management College, Department of Defense Manufacturing Management Handbook for Program Managers, Defense Systems Management College, Fort Belvoir, Virginia, July 1984.

26. Air Force Systems Command, "Profit Study '82 Summary Report", December 1982.

27. President's Private Sector Survey on Cost Control, "Report on Financial Asset Management", September 15, 1983, p. 1.

28. Van Horne, James, C., Financial Management and Policy, Prentice-Hall, Inc., 1983.

29. Ramo, Simon, The Management of Innovative Technological Corporations, John Wiley & Sons, 1980.

30. Office of Federal Procurement Policy, "Federal Acquisition Regulations", April 30, 1985, p. 15-40.1.

31. Office of the Secretary of Defense, "DOD FAR Supplement", April 1984, p. 15.9-4.

32. Air Force Institute of Technology, "Contract Administration", United States Air Force Air University, Wright Patterson Air Force Base, Ohio, 1980, pp. 23-24.

33. Acker, David., D., "The Acquisition Process: A Brief Historical Perspective", Concepts: The Journal of Defense Systems Acquisition Management, Summer 1982, Volume 5, Number 3.

34. _______________, and McAleer, George, R., "The Acquisition Process: New Opportunities for Innovative Management", Concepts: The Journal of Defense Systems Acquisition Management, Summer 1982, Volume 5, Number 3.

35. Christenson, Ronald; Berg, Norman; Salter, Malcolm; Stevenson, Howard, Policy Formulation and Administration, Richard D. Irwin, Inc., 1985.

36. Gordon, Harvey, J., "The Role of the Contract in Systems Acquisition", Defense Systems Management Review, Winter 1980, Volume 3, Number 1.

37. Naval Material Command, Navy Program Manager's Guide, Headquarters Naval Material Command, Washington, D.C., NAVMAT P-9494, 1985.

38. Bennett, John, J., Department of Defense Systems Acquisition Management: Congressional Criticism and Concern, Ph.D. Dissertation, George Washington University, May 1974, p. 192.

39. Knight, Frank, Risk, Uncertainty, and Profit, Houghton Mifflin, Boston, 1921, p. 233.

40. Levy, Haim, and Sarnat, Marshall, Capital Investment and Financial Decisions, Prentice-Hall, 1982, p. 197.

41. Rowe, William, D., An Anatomy of Risk, John Wiley & Sons, New York, 1976.

42. Otway, Harry, J., "Risk Estimation and Evaluation", Proceedings of the IIASA Planning Conference on Energy Systems, IIASA-PC-3, Laxenberg, Austria, International Institute for Applied Systems Analysis, 1973.

43. Kates, Robert, W., "Risk Assessment of Environmental Hazard", SCOPE Report No. 8, International Council of Scientific Unions, Scientific Committee on Problems of the Environment, Paris, 1976.

44. Finnerty, John D., A Dynamic Stochastic Model of Corporate Behavior Over the Business Cycle With a Special Application to the Major U.S. Military Airframe Builders, Ph.D. Dissertation, Naval Postgraduate School, Monterey, California, September 1977, pp. 922-925.

45. Morse, John, P. and Kramer, Kenyon, P., DOD Contractor Profitability, 1980-1984, Master's Thesis, Naval Postgraduate School, Monterey, California, December 1985.

46. U.S. Department of Defense, Directorate of Information, Operations, and Reports (DIOR), 100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards, Government Printing Office, Washington, D.C., FY 1980-FY 1984.

47. Davidson, Sidney; Stickney, Clyde, P.; and Weil, Roman, L., Accounting The Language of Business, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1984, p. 58.

48. Gordon, Sanford, D. and Dawson, George, G., Introductory Economics, D.C. Heath and Company, Lexington, Massachusetts, 1984, p. 176.

49. The Value Line Investment Survey. Published weekly by Value Line, Inc., New York.

50. Myers, Stewart, C., "The Relation Between Real and Financial Measures of Risk and Return", in Risk and Return in Finance, ed. Friend, Irwin and Bicksler, James, Ballinger Publishing Co., Cambridge, Massachusetts, 1977, p. 61.

51. Office of the Assistant Secretary of Defense (Comptroller), FYDP: The Five Year Defense Program Historical Summary and Program Detail FY 1962-FY 1984, May 10, 1985.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3.	Professor Dan C. Boger, Code 54 Bo Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	2
4.	Professor Carl R. Jones, Code 54 Js Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	1
5.	LCDR Wayne A. Martin, USN USS RANGER (CV61) AIMD FPO San Francisco, California 96633-2750	3

219306

Thesis
M3588
c.1

Martin
An empirical assessment of defense contractor risk 1976-1984.